[Jan. 1909?]

Soil mixtures

		Pots	Cultures
1.	Peat 8 parts Sand 1 part Loam 1 part	Whiskey glasses 56	73
2	Mixture 1 2 part Manure 1 part	Whiskey glasses 6	74
3	Mixture 1 4 parts Manure 1 part	Whiskey glasses 6	75
4	Mixture 1 99% Lime 1%	Whiskey glasses 6 Peat 8 " " Sand 1 " " Loam 1 " " Lime 8 cc.	76
5	Rose soil	Whiskey glasses 18	77
6	Sand	Whiskey glasses 12	78, 79
7	Peat	Whiskey glasses 6	80.

UNITED STATES DEPARTMENT OF AGRICULTURE,

BUREAU OF PLANT INDUSTRY,

WASHINGTON, D. C.

OFFICE OF
TAXONOMIC INVESTIGATIONS.

Washington Jan. 11, 1909

Cultures 73 + 74. In all the plants of Culture 73 the terminal rudiment has withered, and the roots have all made excellent growth. In 74, all the leaf tips are growing, but none of the roots have put out any new growth. Incidentally this illustrates the value of transparent pots.

Culture 78. Root growth in all excellent, stem tips withered in 3, rather dormant in 2 others.

Culture 79 Root growth excellent in all, stem tip withered in 4, dormant in 2

Culture 80 Root growth good, though less than in 73, 78, and 79, stem tips withered in 2, growing in the others.

Culture 75. Roots growing a little in all but one, in that none. Leaf tips growing in all

Culture 75A Roots growing fairly well, about as in 80, leaf tips growing in all, but one, in that withered but the new bud developing rapidly.

Culture 76. Root growth very feeble, stem tips dead in 4.

Culture 77. Root growth none or very feeble, stem tips dead in 4

Jan. 12, 1909

Culture 90. Tips withered as follows:

C_1 E_2 G_1 $H_{1,4}$ $I_{1,2}$ K_4 L_4

The tip of J_3 has been eaten off by an insect.

The leaf rudiment in many of the plants is stagnant.

Culture 89 Tips withered as follows:

$B_{1,2,3}$ $C_{1,2,3}$ D_2 E_4 $F_{1,3}$ H_3 $J_{1,4}$ $K_{1,3,4}$

In J1 the tip withered after the development of the first new leaf.

Culture 69. A few of the seedlings beginning to show the rudiment of the first, hairy leaf.

Culture 40. Over the part of the plot still naked there has been no recent germination of seeds. Over the part covered with live whole sphagnum 8 seedlings have germinated since the sphagnum was put on. These and the older plants are slimmer than those in the open. growing underneath the moss ~~the green~~ algal layer has been ~~is being~~ replaced in parts by a dark brown layer of dead organic matter consisting of the excrement of some minute animal. Apparently the algal layer is being eaten.

Jan. 12, 1909.

Experiment

Try the relative osmotic ~~effect~~ pull in the soil solution of kalmia peat (Culture 80) and kalmia peat & loam 1 and sand 1 (Culture 73) as opposed to a heavily manured soil (Culture 74) to ascertain whether the withering of the leaf tip in 73 and 80 and its continued growth in 74 is not correlated with a greater difficulty in 73 and 80 in getting water for transpiration purposes.

Jan. 13, 1909.

Cultures 74, 75, 75A. It is to be noted that in all these cultures containing manure all the plants except one isolated [illegible] undisturbed in 75A have ~~[illegible] the growth of~~ kept [illegible] ~~not lost their growing~~ and have not lost them by ~~[illegible]~~ withering as has happened in many of the ~~[illegible]~~ plants in the sand, peat, lime, rose, ~~[illegible]~~ and blueberry soils. (See recent records for Cultures 73, 76, 77, 78, 79, 80, 89, 90.

UNITED STATES DEPARTMENT OF AGRICULTURE,
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OFFICE OF
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Jan. 14, 1909.

An important discovery was made this [illegible]
with reference to the character of the kalmia
peat that must be used for growing ~~the~~
Vaccinium corymbosum successfully.
In all the cultures from 43 to 53 growth
has been excellent, and the leaf rudiment at
the tip of the stems did not wither after trans-
planting. In all the peat cultures from
54 onward growth has not been good,
the ultimate leaf rudiment commonly stop-
ped after transplanting and in a con-
siderable percentage of cases withered, a dark
purplish hue became prevalent on the old leaves,
and on such plants as developed new
growth the leaves are small.
Cultures 43 to 53 were potted Nov. 11 or earlier,
Cultures 54 and later ones November 24 or later.
It was on November 18 that the first load of
new peat was delivered at the greenhouses.
Cultures 43 to 53 were potted in peat that had
remained, rotting, in the pile under the shed from the
preceding year. Cultures 54 and later in
fresh unrotted peat.
In its natural position the blueberry roots pene-
trate only into the decomposed peat not into the super-
ficial layers of unrotted leaves. In preparing
our cultures the [illegible] moss leaves and all is chopped
up or rubbed through a sieve [illegible]

Cuttings 4 [illegible] Jan 18, 1911

A 2
A 3
B 3
D 1
D 3
D 4
E 1
G 5
H 1
H 2
I 1
I 4
K 5
M 2
M 4
M 5

A4 Withered Jan. 17, 14 leaves, branches 3.5 + 3.7 cm, cotyledonary

C1 Withering Jan. 16, withered Jan. 17, 18 leaves, shoot 8.0 cotyledonary
C4 " " " " " 14 leaves, shoot 7.0, [illegible]

D5 Withering Jan. 17, withered Jan. 18, 15 leaves, shoot 3.7 [illegible] second axil
E3 Withered Jan. 17, 20 leaves, shoot 4. cm, from first axil
[illegible] withering Jan. 15, withered Jan. 16, 16 leaves, [illegible] 4.5 cm from first axil.
E1 withering Jan. 15, 16 leaves, shoot 4.5 cm, third axil
E3 " " " 17 leaves, shoots 1. + 1.5 cm, first and second axils

I4 withering Jan. 15, withered Jan. 16, 16 leaves, branch 3 cm., cotyledonary

L5 withering Jan. 18, 18 leaves, shoots 4.2 + 3.5 cm, first and second axils respectively.

N1 withered Jan. [illegible], 17 leaves, branches 3.5 + 2.5 cm, first and second axil
P5 withered Jan 17, 13 leaves, branch 5.5 cm, first axil

Buds wanting on
H 3
J 1
O 2

Bud in 4th axil Jan 18, 1911

Branches wanting on
K 5
L 2

Jan. 14, 1909

Seedlings from Brooks bush, '08

Transplanted

Culture	43	79
	44	44
	45	12
	46	24
	47	55
	49	55
	50	32
	51	56
	52	4
	53	48
	54	4
	55	82
	56	82
	57	4
	58	4
	59	4
	60	4
	61	4
	62	4
	64	40
	65	43
	72	163
	73	6
	74	6
	75 / 75A	6
	76	6
	77	6
	78	6
	79	6
	80	6
	81	56
	90	56
		1013

Jan. 14, 1909

Culture 74. One with tip withered

Culture 43. Additional plants with withered tips as follows:

A_3, 16 leaves, branches 0.5 and 6. cm, ~~from~~ cotyledons

D1, 13 leaves, branches 3. and 6. cm, cotyledonary

D3, 13 leaves branches 5. cm, first epid.

I5, 17 leaves, branch 4. cm, third epid.

J5, 14 leaves, branches 4. + 4.5, cotyledonary

Jan 15, 1937.

Culture 74. There has been a slight amount of root growth in some, but not all the plants, but the growth is short, thicker than usual, and the surface cellular corrugated

Jan. 15, 1909

The Kalmia peat used in potting Cultures 43 to 53 was delivered at the Department June 12, 1908. ~~Whether~~ it was freshly gathered at that time is not known.

Jan. 16, 1909

Culture 41. Many of the Kafirnin seedlings are showing the minute, hairy first leaf, still much smaller than the cotyledons.

Jan. 16, 1909

Culture 91. Thirty plants from Culture 37, transplanted to half of a flat in a soil of pure Kalmia peat taken from the lower surface of the peat clods ~~from~~ in the 30-barrel lot bought by the Department 1908. Rubbed through a quarter-inch sieve. Soil rubbed from the roots with the finger

Culture 92. Twenty-five plants same as 91 except the soil, this made of the whole peat clod, upper layers and all, chopped and then rubbed through a quarter inch sieve. Planted in same flat as 91

Culture 93. Twenty-five plants, same flat as 91 + 92, same soil as 92, but with 1 part by bulk of cow manure added to 20 parts of the peat. The cow manure was freshly rotted, unleached manure, dried under cover and pulverized by rubbing through a fine screen.

Jan. 18, 1909.

Culture 43

Tips withered

A 2 B4 Tip broken or eaten long ago.

A 3 B, withering Jan. 20, 16 leaves, shoots 4.3 + 5 cm, cotyledon ax

A 4 B2 " " " 15 leaves, shoot 5 cm., cotyledon ax

B 3 B5 " " " 15 leaves, shoot 7 cm, cotyledon ax

C, C2 withering Jan 20, 16 leaves, shoot 1.5 cm, coty. ax.

C4 C3 withered Jan. 19, 15 leaves, shoots 4 + 1.2 cm, coty.

D,

D 3

D 4

D 5

E,

E 2

E 3 F, withering Jan. 19, 15 leaves, shoot 5.5 cm, first axil

E 5 F2 withered Jan. 20, 16 leaves, shoot 4.6 cm., first axil

G 3 F3 withered Jan. 19, 15 leaves, shoot 4.5 cm, first axil

G 5

H,

H 2

H 4

I 4 I5 Withered Jan. 21, 18 leaves, shoot 6. cm., coty.

J 4 J5 Withered Jan. 21, 17 leaves, shoots 3.2 + 3.6 cm, ...

J 5 K4 Withered Jan 21, ...

K 2 L, withered Jan. 20, 20 leaves, shoots 8 + 6. cm. first + third

L 5

M 4

M 5

N, N5 withering Jan. 19, 18 leaves, shoot 1.6 cm, second axil

P 5

Buds wanting

H 3

I,

Branches wanting

H 5

L 2 Jan. 20 branches 2 and 2 mm., 3rd + 4th axils

O 2

Jan. 15, 1907

Culture 90 Tubes filtered as follows:

C_2
E_2
D_1
H_1
I_1
I_2
K_4
L_4

The plants in 90 are much less purple than those of Culture 89.
They have been in a warmer house and perhaps have had less sunlight.

Jan. 18, 1909

Cultures 89. Leaf rudiments withered as follows:

A_4
B_1
B_2
B_4
C_1
C_2
C_3
D_2
E_4
F_1
F_3
H_3
I_3
J_1
J_4
K_1
K_3
K_4
L_2

Jan 19, 1939

Culture 89. Plunged the pots in live sphagnum in the flat ~~yesterday~~. The twenty-two plants with withered tips placed at the label end of the flat.

Culture 90. Plunged in sphagnum like 89. Eight plants with withered tips and 2 with bad tips placed at the label end of the flat

Jan. 20, 1909.

Large bud formed last fall on the largest shoot of the largest plant in the aquarium. Bud 10 mm. long. Axil of basal bract containing a bud composed of bracts. Second axil the same. Third axil the same. Fourth axil empty. Fifth axil same as first to third. Sixth empty. Seventh axil containing a flower bud with an extra bractlet on the pedicel above the two regular ones. Eighth same as seventh, but the flower bud withered. Ninth same as eighth but without the third bractlet. Tenth same as ninth. Eleventh same. Twelfth same. Thirteenth same but flower not withered. Fourteenth same as thirteenth. Fifteenth same. Sixteenth same. Seventeenth same. Eighteenth same, flower bud withered. Nineteenth same, but flower not withered. Twentieth same, but flower withered. Twenty-first empty.

C. Stevia of 1907 seedlings. Twelve flowers so far, ten pollinated, one dropped without pollinating, one not yet pollinated.

Jan. 20, 1909.

Day before yesterday I examined two of the cultures made by Mr. Kellerman in October, 1908, from the roots of seedling Vaccinium plants.

One, a pale brown fungus, showed necklaces of conidia-like cells borne on a small tree-like branched hypha arising from the agar. In the same culture were nearly black stellate structures (under a hand lens) which proved to consist of ~~a~~ strings ~~succession~~ of teleuto-spore-like dark-colored bodies. Mrs. Patterson to-day sends me an identification of the contents of this tube as Alternaria (with the stellate dark bodies) and Oospora (with the necklace-like conidia).

The second culture was a white fungus covering the surface of the agar with its hyphae and bearing grape-like clusters of conidia-like bodies borne on club-shaped branches. This Mrs. Patterson calls questionably a Sporotrichum?

No one of these fungi is at all related to the pycnidia-bearing mycorhiza grown by Miss Ternetz as a Phoma.

UNITED STATES DEPARTMENT OF AGRICULTURE,
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OFFICE OF
TAXONOMIC INVESTIGATIONS.

Jan 20, 1907

Culture 72. Top of one box sprinkled with a thumb pot full of pulverized sheep dung, to see if the harmful action of the raw peat can be corrected.

Culture 75 A The plants of this culture are notably better than those of any of the cultures from 73 to 80. The small amount of manure appears to have corrected the deleterious tendency of the raw peat in 73, and to have avoided the killing of the roots by too much manure in 74.

Jan. 2, 1909

Cultures 91, 92, 93, No tips withered — true

for

Cultures 73 Tips all withered

74 Two tips withered

75 One " "

75A One " "

76 Four " "

77 " " "

78 " " "

79 " " "

80 Two " "

Culture 43 Jan 21, 1907

Tips not withered

- A5 Proves to have lost its tip long ago
C5 Withered Jan. 24, 14 leaves, shoot 6. cm. first axil.
D2 Withering Jan. 23, 15 leaves, shoot 6.3 cm, first axil
E4
F4 Withered Jan 23, 14 leaves, shoot 9 cm, first axil
F5 Withered March 5, 20 leaves, shoots 17.4 + 16.5 cm, first & sec. axil
G1 Withered Feb. 25, 23 leaves, shoots 14.5 + 22, cot. [illegible]
G2 Withered Jan. 28, 15 leaves, shoot 5. cm, cotyledonary
G4 Withered Feb. 17, 24 leaves, shoots 5.5 + 7.5 cm. first [illegible] second axils
H3 Withered Feb. 16, 17 leaves, shoots 1.7 + 2.9 cm, cotyledonary
H4 Withered Feb. 15, 20 leaves, shoots 1.5, 1.5, + 1.3 cm, cot. + first axil
H5 Withered Feb. 15, 20 leaves, shoots 2.3, 2.5, 3.7 cm, cot. + first axil
I1 " " " 22 leaves, shoots [illegible] shoot 13. cm, [illegible] axil.
I2 Withering Feb. 12, 19 leaves, shoots 1.4 + 3.5 cm, first + [illegible]
I3 Withered Jan. 23, 16 leaves, shoot [illegible]
J1 Withering Jan. 22, 20 leaves, shoots 3 + 4.5 cm, first [and second axils]
J2 Withered Feb. 12, 19 leaves, shoots 3.5 + 4.5 cotyledon and first axil
J3 Withered March 5, 22 leaves, shoot 15.3, cotyledonary.
K1 Withered Feb. 22, ~~19~~ leaves, shoots 3, 5.8, + 12. cm, cot., first, + sec. axil
K3 " " " 21 leaves, shoot 7.5 cm, first axil.
K5
L2 Withered Feb. [illegible], 19 leaves, shoots 3.5 + [illegible] cm., [illegible]
L3
L4 Withered Feb. 19, 18 leaves, shoot 7 cm, cotyledonary
M1 Withering Feb. 6, 22 leaves, shoot 13 [illegible]
M2 Withered Jan. 22, 13 leaves, shoots 3.2 [illegible] 4.5 cm, [illegible]
M3 Withered Feb. 25, 26 leaves, shoots 17 + 19.6 [illegible]
N2 Withered Jan. 23, 15 leaves, shoot 7.1 cm, first axil.
N3
N4 Withered Feb. 22, 20 leaves, shoots 2.5 + 16, cot. + 3rd axil.
O1 Withering Jan. 22, 14 leaves, shoot 12 cm, cot. [illegible]
O2 Withered Feb. 22, 21 leaves, shoots 1.5 + 3. cm, cot.
O3 Withering Jan 23, 18 leaves, shoot 6.2 cm, [illegible]
O4 Withered Mar. 5, 18 leaves, shoots 15. + 32. cm, first + third axil
O5 Withered Feb. 25, 22 leaves, shoot 11. cm. first axil
P1 Withered Feb. 12, 19 leaves, shoots 12.5 cm + 7.5 [illegible] second axil +
P2 Withered Feb. 7, 19 leaves, shoots 2.5 + 11. cm. cot. + [illegible]
P3 Withering Jan 23, 18 leaves, shoot 5.5 cm [illegible]
P4 Withering Feb. [illegible], leaves 17 shoot 12. [illegible]
withered shoot
[illegible] 23 30, 7.1 [illegible] (over)

June 22, 1909

Cutting 69. First leaf on some of the Kalmia plants as large as a [illegible] [illegible]

Jan 23, 1907

Culture 91. One tip withered, B_4

92. No tips withered

93. Three tips withered L_4, M_1, P_1

Jan 25, 1907

Culture 91 Tips withered A_1 B_1 B_4 E_4 E_5

92 No tips withered

93 Tips withered L_3 L_4 M_1 O_5 P_1

Jan. 26. 1907

Culture 91 Also withered F_1

Jan 27

Culture 91 Also withered A_5

93 Also withering, but apparently not a withering of the usual type, P_5

Jan. 28

Culture 92 Tip blackening, G_3

Jan. 29

Culture 91 Also withered E_2

Culture 92 Tips withered G_3

Abst. V, January 27, 1909

In an endeavor to secure mycorhiza-free plants upon which to try inoculation experiments with the pycnidia-fungi grown from the roots of Ericaceae and Vacciniaceae, seeds from various plants were superficially sterilized in 1% hydrochloric acid or 1% formol, washed in sterilized water, and sowed on slices of sterile peat in glass boxes (Glasdosen) with ground-glass covers. The peat had been twice sterilized, at an interval of one to two days, at a temperature of 120°C.

Seeds were used from Calluna vulgaris, Andromeda polifolia, Oxycoccus oxycoccus, Vaccinium myrtillus, V. vitis-idaea, and V. uliginosum.

In no case were mycorhiza-free plants secured. The seeds of Vaccinium and Andromeda almost always failed to germinate. Those of Calluna germinated fairly, often in ten to twelve days, and although the seedlings at a height of 1 to 1.5 cm. showed no trace of a root fungus, at 2.5 to 3 cm. not a single plant could be found wholly free from it.

over

Bor

The sterilization of the seeds, especially in Calluna was necessarily very imperfect on account of the adherent air

Ternetz 1907, 358.

United States Department of Agriculture,

OFFICE OF CHIEF CLERK.

WASHINGTON, D. C. ...., 1895.

MERCHANTS' DELIVERY CO.,
912 Pennsylvania Ave., N. W.,
Washington, D. C.

Gentlemen:

Please call at ....

for ....

and deliver the same at ....

Very respectfully,

....
Chief Clerk.

Abstract, Jan. 22, 1909.

Pycnidia develop in the crude culture only in the relatively few cases in which there is little contamination by bacteria and molds. In these cases the pycnidia appear in 5 to 16 days on the average.

Ternetz 1907, 360

The pycnidia fungi show their characters best in testtube cultures (Reagensglas - Strichculturen)

Ternetz 1907, 361.

United States Department of Agriculture,

OFFICE OF CHIEF CLERK.

WASHINGTON, D. C. ...., 1895.

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Chief Clerk.

Abstract, January 22, 1909

The pycnidia-fungi were obtained as follows:

Pieces of young roots of Ericaceae and Vacciniaceae† 2 to 4 mm. long, were washed in 1% hydrochloric acid and then in sterilized water. They were placed in petri dishes and moist chambers on a culture medium consisting usually of 2% agar with a decoction of peat or rhododendron leaves added.

In the moist chamber cultures a strong septate mycelium developed in 24 hours and after a couple of days took on a brownish color. The cultures were frequently contaminated, especially with *Penicillium glaucum* and *Mortierella rostafinskii*, sometimes preventing entirely the growth of the root fungus. Ternetz 1907, 356.

† *Calluna vulgaris*, *Andromeda polifolia*, *Erica carnea*, *E. tetralix*, *Vaccinium myrtillus*, *V. vitisidaea*, *V. uliginosum*, and *Oxycoccus oxycoccus*.

United States Department of Agriculture,

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Chief Clerk.

Abstract, Jan. 22, 1909.

The pycnidia vary in size from
a small pinhead (176 to 196 μ) in the
root fungus of Oxycoccus to less than
half that diameter (76 μ) in *Vaccin-
ium myrtillus*.

The spores vary from 3.9 to 5 μ
in length and 1.3 to 3 μ in thickness

The plants were grown on a mixture
of equal parts of a 2% agar solution and
a decoction of the leaves of *Rhododendron
ponticum*. The decoction was made with
50 grams of the fresh leaves boiled two
hours in 1000 cc. of distilled water, filtered, and
the filtrate concentrated (eingeengt) to
400 cc. and again filtered. When a
decoction of beet instead of Rhododendron
was used the development of the
leaves was extremely poor.
fungi

Ternetz 1907, 365 to 369.

United States Department of Agriculture,

OFFICE OF CHIEF CLERK.

WASHINGTON, D. C. ________________, 1895.

MERCHANTS' DELIVERY CO.,
912 Pennsylvania Ave., N. W.,
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for ____

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and deliver the same at _________________________

____

Very respectfully,

____
Chief Clerk.

Abstract Jan 23, 1909

In *Azotobacter chroococcum* the proportion of nitrogen to the dry weight is 10% to 12%, in the root fungus of *Andromeda polifolia* and *Oxycoccus oxycoccus* 17% and 18%, all grown in nitrogen-free solutions.

Ternetz 1907, 387

In *Clostridium pastorianum* grown in a nitrogen-free solution for each gram of dextrose consumed there was fixed 1.34 mg. of atmospheric nitrogen, in Azotobacter *chroococcum* 10.66 mg; in *Pseudomonas radicicola* 11.6 mg; and in the root fungus of *Oxycoccus oxycoccus* 18 mg.

Ternetz 1907, 389.

UNITED STATES DEPARTMENT OF AGRICULTURE,

BUREAU OF PLANT INDUSTRY,

WASHINGTON, D. C.

abstract Jan. 23, 1907.

The nitrogen-free culture solutions used to determine the capacity of the root fungi for absorbing atmospheric nitrogen were made up as follows:

	For most of the cultures	Variations
Dextrose	7%	2 to 20%
KH_2PO_4 (acid potassium phosphate)	0.5	.01 to 1
$MgSO_4$ (magnesium sulphate)	.01	.002 to .2
$CaCO_3$ (calcium carbonate)	.01	.01 to 4
NaCl (salt)	Trace	Trace
$FeSO_4$ (ferrous sulphate)	Trace	Trace

Cane sugar (2%, 10%) or mannite (2%) were sometimes substituted for dextrose, and $MgCO_3$ for $CaCO_3$.

Ternetz 1907, 365-367.

UNITED STATES DEPARTMENT OF AGRICULTURE,
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OFFICE OF
TAXONOMIC INVESTIGATIONS.

Jan. 23, 1909

Miss. Ternetz in accounting for the unusually small growth of one of her root fungus cultures said that the explanation was to be found in the slight bacterial contamination of the culture, and states that all the root fungi are very sensitive to such contamination.

This suggests the importance of sterilizing with peroxide of hydrogen the pieces of root used in starting cultures.

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF PLANT INDUSTRY,
WASHINGTON, D. C.

OFFICE OF
TAXONOMIC INVESTIGATIONS.

Jan. 27, 1908

Culture 69 Many seedlings with the first leaf as large as the cotyledons, and the rudiment of the second leaf evident, one plant with the first leaf twice as long as the cotyledons.

Jan. 25, 1909.

Culture 89. Four more plants with withered tips placed ~~near~~ toward the label end of the flat to-day, making 27 withered and 21 not.

Lycopersicum culture. Cut ~~the stem of one of~~ at the base one of the branches that was layered a few months ago. It is firmly rooted.

Culture 90 No more plants with withered tips.

Jan. 28, 1909.

A bag of ~~shaken~~ peat prepared today by Mr. Fraile and placed under a bench in the greenhouse. Kept watered. This is expected to avoid the troubles of Cultures 55, ~~&~~ 56, et seq.

Jan. 27, 1909.

Culture 91. Tips withering A_1 A_5 B_1 B_4 E_2 E_4 E_5 —
F_1 ~~E_3~~

Culture 92 Tips withering G_3

Culture 93 Tips withering L_3 L_4 M_1 O_3 P_1 P_3 —

Jan 30

In 91 D_1, F_2 withering

Feb 2

No change

Feb 3

In 91 withering C_3

Feb. 4

No change

Feb 5

No change.

Feb. 6

No change

Feb. 8

In 91, withered, A_4

Feb. 9

In 91, withered, B_3

Jan. 27, 1907.

Take a barrel of fresh Kalmia peat containing oak roots and prepare portions as follows:

1. Rub a portion of the fresh peat through a sieve, roots upper leaf layers and all.
2. Shake out a portion of the fresh peat, so that it contains no freshly killed roots.

Make drained places for plantings with these two soils and watch the effect of the freshly killed roots.

3. Shake out a portion of the fresh peat from the under side of clods so as to have neither roots nor ~~ }~~ upper layers of leaves.

Make a drained place for planting with this soil, the growth of the plants to be observed in comparison with those of no. 2, which contains none of the upper leaf layers.

4. Take out a set of clods and dry them until the roots are dead and dry. Then moisten

them and lay in a pile to decompose. ¶At intervals of two weeks make drained glass pot plantings ~~of~~ this soil and ~~in pockets of portions of~~ the undried clods, both freshly prepared in the same manner as no 1.

~~4~~ 5 Take a bushel of year-old well rotted kalmia peat.
Make ~~a~~ checks ~~of~~ plantings, in drained glass pots, to go with 1, 2, + 3 and another to go with each of the no. 4 plantings.

Jan 29, 1909.

Cultures 74, 75 + 75 A. It is clear that in these cultures which have lost [illegible] are growing [illegible] each, and in which the tops are growing well, the manure (and % respectively) has acted so as to offset to a conspicuous degree the injurious effect of the fresh peat exhibited in Culture 73. Fair root growth and good top growth is taking place in 75 and 75 A. In Culture 74 the amount of manure (%) is so excessive as almost to inhibit root growth, roots showing in only two pots and these very scantily. The top growth in 74 is now very slow the plants averaging only 3.4 cm. in height as opposed to 5.3 cm. in 75 and 5.9 cm in 75 A.

Cultures 78 and 79. The root growth is extensive, but the tops have made essentially no growth and [illegible] leaves show the dark purple color more conspicuously than 73 and 80, and quite as conspicuously as 64, 65, and [illegible]. Their average height is 78, 3.7 cm 79, 3.9 cm.

Jan. 29, 1909.

Culture 91. The plants of this culture are doing notably worse than those of Cultures 92 and 93. The tips have withered in 27% as opposed to 4% in 92 and 24% in 93. Stagnation of the ultimate leaf rudiment is more evident in 91 than in the others. The tendency to develop a dark purple color in the old leaves ~~is much more~~ ~~pronounced~~ is conspicuous in 91, not at all observable in 92 + 93.

In 91 the peat ~~soil~~ contains many broken ~~leaves~~ roots probably killed by rubbing the peat through a sieve. In 92 and 93, prepared in the same way a few ~~several~~ weeks ago these roots have presumably had time to decompose to a sufficient extent to render them innocuous.

The oak roots in the peat clods placed in the shed in November are still alive.

Jan 30, 1909

Culture 76. All but one of the plants have their tops withered, and that one has its leaf rudiment dormant. In all the tendency to be purplish-leaved is pronounced. All have made a little new root growth. The average height of the plants is 4.1 cm.

Culture 77. Two plants still have their tips alive but stagnant. Root growth is very feeble. The old leaves are strongly purplish. The average height is 3.7 cm.

Barrel of freshly gathered kalmia peat delivered this morning. Placed in chrysanthemum house. Portion of the clods laid out in the green-house to dry.

Feb. 2, 1909

Culture 69
No more tips wilted. Plants now beginning to grow.

Cultures 55, 56. These plants have been growing well for at least two weeks past. The old leaves have lost their purple color

Cultures 57 to 62, 64, 65. The plants are now putting forth new growth though many have the old leaves still purple.

Cultures 72. The plants in both flats are growing, some of them however, with old leaves still purple.

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF PLANT INDUSTRY.

EXPERIMENTAL GARDENS AND GROUNDS.

Washington, D. C.,

Feb. 3, 1909.

Cultures 41, 42 etc. In none of the plants of the 1907 seeding, brought into the greenhouse about Dec. 1, after having shed their leaves and ripened their wood out doors, has any good new growth taken place. Twelve plants have flowered with 50 with flower buds, and the flowering buds of some of the remaining. One hundred and one plants out of 206, including those in glass pots, give no indication of growth whatever, their buds having not even swollen. In only a very few of the plants has any new root growth taken place. The wood and buds are in the main in good condition, little shriveling having taken place. The new branch growth has been feeble, the tip usually withering after the development of 4 or 5 leaves, and most of these the small leaves characteristically produced from opening buds. [illegible] shoots have been produced.

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF PLANT INDUSTRY.

EXPERIMENTAL GARDENS AND GROUNDS.

Washington, D. C.,

Feb. 4, 1909.

Culture 69. Second leaf in many of the plants as large as the cotyledons.

Feb. 5, 1909

Culture 67. One cutting dead one with ~~s~~ scanty top and root growth not repotted. Four plants repotted in 3 inch pots in Sand 1, loam 1, shaken peat 8. Remaining five plants made into 67A

Culture 67A Five plants of Culture 67 repotted today in 3-inch pots in sand 1, loam 1, Bissett leaf mold 8. All the nine plants in 67 that were repotted had an abundant growth of roots at the wall of the thumb pots.

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF PLANT INDUSTRY.

EXPERIMENTAL GARDENS AND GROUNDS.

Washington, D. C.,

Feb. 5, 1909

Soil 1. Shaken peat. Nov. , 1908, peat taken from pile Jan. 1909, shaken out and left since in a bag in the greenhouse.

Soil 2. Mold. This is rotten oak and maple leaves rotted 4 or 5 yrs. by Mr. Bassett on Mrs. Hubbard's place.

Soil 3. Fresh peat, rubbed. Kalmia peat delivered Jan. 30, dried six days, then rubbed through a sieve, all the roots going through. Moistened.

Soil 4. Vaccinium peat chopped. Same as 1, but taken from pile & chopped to day, so as to keep all the roots in. Some are still alive.

Soil 5. Same as 4, but rubbed through a quarter inch sieve, little of the roots going through.

Feb. 11, 1909

Soil 6. From culture 43, [illegible].
7. From Culture 35, [illegible]
8. From culture 74 [illegible]
9. " " 75, one fifth [illegible]
10. " " 75A, one ninth [illegible]

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF PLANT INDUSTRY.

EXPERIMENTAL GARDENS AND GROUNDS.

Washington, D. C.,

Feb. 6, 1909.

Culture 78. Three of the plants have their lower leaves withered to-day, after a bright warm day, but the upper leaves are still green. No one of these plants have made any root growth so far as observed.

Culture 99. Sixteen plants from culture 39, transplanted to-day to a 6 pot, 2½ inches apart in a soil consisting of Kalmia peat (shaken from rose pot in Jan.) 8 parts, sand 1 part, loam 1 part.

Culture 100. Sixteen plants same as ~~those~~ of 99, but soil: leaf mold (Bissett) 8 parts, sand 1 part, loam 1 part.

Culture 101. Twenty plants same as culture 99, but soil 4 parts peat, 4 parts leaf mold, 1 part sand, 1 part loam.

UNITED STATES DEPARTMENT OF AGRICULTURE,

BUREAU OF PLANT INDUSTRY,

WASHINGTON, D. C.

Feb. 6, 1909

Culture 94. Six plants from Culture 39, carefully taken up and the soil washed off, the plants then potted in thumb pots in Soil 1 of Feb. 5.

Culture 95. Same as 94, but potted in Soil 2.

Culture 96. Same as 94, but in Soil 3

Culture 97. Same as 94, but in Soil 4

Culture 98. Same as 94, but in Soil 5.

Feb [illegible] [illegible],

[illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] withdrawn [illegible] in $E_{3,4}$ [illegible] [illegible] [illegible] [illegible] [illegible] before [illegible] [illegible] [illegible] [illegible]

Feb. [illegible] [illegible]

[illegible] 99 [illegible] withdrawn B_1

100 C_1

101 [illegible]

[illegible] [illegible] [illegible] [illegible] [illegible]

Feb. [illegible], 1901

In 99 [illegible] withdrawn A_1, C_1, D_2 D_3

In 100 " " E_4, G_1 G_2 ([illegible] [illegible]

[illegible] [illegible] [illegible] withdrawn).

In 101 [illegible] K_3

Feb. [illegible]

In 99 withdrawn A_2 [illegible],

In 100 E_1

In 101 " K_1 [illegible] [illegible] M_2

Feb. 8, 1909

The dried fresh peat laid out about two weeks ago was separated into two portions yesterday. The first portion was rubbed through a quarter inch sieve. The turfs were not yet quite air dry, and some of the roots did not pulverize. These were laid aside for further drying. The part that was rubbed through the sieve was also spread out to dry.

Feb. 9

The ~~sieved~~ part was wet thoroughly and placed in a 12-inch pot to decompose.

The dried roots were rubbed through a quarter inch sieve, ~~and~~ put in a 4-inch pot wet with water and left to decompose.

The remainder of the dried peat turfs was moistened and put into a box to decompose.

Feb. 9, '94

Culture 91 Tips withered A_1 A_4 A_5 B_1 B_3 B_4 C_3 D_1 E_2 E_4 E_5 F_1 F_2

Culture 92 Tips withered G_3

Culture 93 Tips withered L_3 L_4 M_1 O_5 P_1 P_5

Feb. 10.

No change as to withering. In 91 however, all the tips not withered are elongated, except perhaps A 2 and B_5. In 92 and 93 the growth of the tips is renewed.

Feb. 11

In 92, tips [illegible] L_5

Feb. 12 & 13

No change

Feb. 15

In 91 [illegible] more tips withered but [illegible] growing on A_2 B_5 C_5 E_5 D_5 [illegible] F_5

In 92, no more tips withered, good growth [illegible]

In 93, same as 92

Feb. 16

No change.

Feb. 8, 1909

Culture 73. The alfalfa plants of this number were unpotted to-day the roots being carefully taken from the soil

Culture 102. Cuttings of mature winter wood from the Brooks bush were received to-day from Ralph Holt, Greenfield, N. H., in excellent condition. Five of them were turned over to Mr. Gages, to try rooting in a sand bed, with bottom heat and protected by a bell glass.

These scions were packed in moist live sphagnum in a large pot and placed in a cold frame to await the starting of the plants to be grafted.

Feb. 9, 1937

Photographs taken by Doyle as follows

Culture 43

39 One of the [illegible] from which [illegible] plants have been taken recently.

44–45.

55. Had a [illegible] of [illegible] plants [illegible] growing [illegible],

[illegible] 57 Plants [illegible] growing [illegible]

[illegible]

76 (one [illegible]) and 77 ([illegible])

7[illegible] ([illegible] in [illegible] soil) and 77 (blueing in sand).

77 [illegible], 4 plants

73 Rose [illegible]

77 [illegible] 77c

47

67

67A

6[illegible] [illegible]

77

69

69

Feb. 9, 1909.

The layered branch cut off from the geranium plant a few days ago is not doing well. The leaves that fell off a day or two after the branch was severed, are blotched with red, and are somewhat yellowed.

Culture 37 Feb. 10, 1909

About January 4, the remaining 19 cuttings ~~of Culture~~ ~~of Culture 37~~ were taken up and ten of them which had rooted were potted in ~~[illegible]~~ [illegible] peat and placed under a bell jar. These were removed from the bell jar yesterday. To-day they were given the number 103. The remaining cuttings, ~~cuttings~~ without roots in January, were put back in the sand under a bell glass.

To-day the remaining cuttings, 8 instead of nine, that were not yet rooted in early January, were taken up and the three rooted ones (one with a big callus, 13 mm. in diameter) were potted in peat 8, sand 1, loam 1, numbered 104, and put [illegible]. The remaining 5 were put back [illegible] in the sand again under a bell ~~jar~~ glass

Feb. 11, 1917

Unit of Mr. Brazeale

is number of cubic centimeters of one twentieth normal solution required to neutralize, the soil solution from 10 grams of air dry soil. This is the equivalent of about 500 pounds of lime per acre of ordinary soil

Feb. [illegible] '31

Cultures 55. 56. Growing rapidly now, many of the new shoots 5 to 7.5 cm. long.

[illegible] Feb. 4, 1918

Soil 11. From 76, [illegible]

12. From soil 73, roots of alfalfa plant grown near blueberries, [illegible]

13. From 77, alfalfa plant, [illegible]

Feb. 14, 1918

14. Same as 3, but rubbed out on Feb. 9, and kept moist, used in culture 106.

15. Peat roots. The roots, chiefly the brown, were rubbed out of the peat on Feb. 9, and kept moist.

Feb. 23

16. Peat. From bag of shaken peat. Used for infecting 44, 45.

17. Peat. Same as 14, but rotted longer. taken from surface

18. Peat. Same as 17, but taken from deeper in the bed where the peat is moister, more compact, and less well rotted.

19. Peat roots. Same as 15 but [illegible] longer.

Feb. 2, 1904

Cultures 94, 95, 96, 97, 98.

Only tip withering therefore, in 95.

Plants shaded with paper, as for [illegible]
shade removed Feb. 12

Culture 99, 00. A plant in each has withered the tip of its main lateral branch, and others show the [illegible] enlargement preparatory to withering.

Feb. [illegible]

Cultures [illegible]

Feb. [illegible]

[illegible] 94. No [illegible] withdrawn

95 One [illegible] withdrawn

96 No —

97 One

98 No — Feb. [illegible]

95 [illegible] [illegible]

[illegible] [illegible]

96 None

97 Two

98 One

Feb. [illegible]

98 Two [illegible] [illegible]

Feb. 17

95 Three withdrawn

96 Two "

97 Three "

[illegible]

Feb. [illegible]

99 Two withdrawn

Feb. [illegible]

Culture 44. Three tips withered on second shoots

Culture 46. One tip withered

Culture 47. Two tips withered

In many of these cases the branch is only [illegible], but the others are making normal growth. The most vigorous growing branches in these [illegible] are [illegible] [illegible]

Culture 67, 67A. In two cases (following [illegible]) the growth has taken place in only the [illegible] growth unit.

[illegible]

Soil 20. Soil from a rose house plant of Culture 41 which has remained stagnant and dormant since before October last, in the rosehouse.

Soil 21. A part of the surface mulch from the same pot.

Soil 22. Cow manure brought into the greenhouse from the manure pile, part used in Culture 74, 75, + 75A, and the rest since dried.

Soil 23. Cow manure from the pile in the shed, same originally as 22.

Soil 24. From the top of the barrel of peat rubbed out by Mr. Fowle a few weeks ago

Soil 25. From deep down in the same barrel as 24.

Feb. 19 — [1897]

window all afternoon, and all
winter. Flower buds of Culture 23
started yesterday. Buds, probably
leaf buds of Culture 19 started
after several days warm weather.

The plant numbered 23 was brought
inside Feb. 17.

Culture 105. Feb. 5 1897

Kalmia plants from Culture 69, having the third leaf from the cotyledon, length 3 mm high, potted into thumb pots in soil as follows (mixed Feb. 1)

Kalmia peat, shaken	6 parts
Leaf mould ( )	2 "
Sand	1 "
Loam	1 "

Potting done by Miss Bryson

Feb. 8, 97.

Culture 106. Four plants from Culture 69 [illegible] and potted in 5 g. [illegible] [illegible] glasses in a soil of Feb. 7 [illegible] peat 8, sand 1, loam 1.

Culture 107. Same as 106 but in shaken [illegible] peat 6, sand 1, loam 1.

Culture 93, Plants with a branching [illegible] [illegible] [illegible]

A, A, A, E, E, [illegible] [illegible] K, K, [illegible] K. [illegible]

[illegible]

Feb. 16, 1905

Cultures 99. Tips withered $A_1\ A_3\ B_4\ C_1\ D_1\ D_2\ D_3$

100 " " $E_1\ E_3\ E_4\ H_1\ H_2$ (H_1 [illegible])

101 " " $J_4\ K_2\ K_3\ L_1\ L_2\ L_3\ M_2$

Feb. 17

Cultures 99 Tips withered $B_2\ B_3$

Cultures 101 " K_4

Feb. 19

Cultures 100 tips withered H_3

101 " " $L_3\ L_4\ M_1$

Feb. 22

Cultures 101 tips withered J_2

A few of the leaves in 99, and about the leaves [illegible] in 101 show a tendency to the [illegible] of the old leaves. In 100 none of the old leaves appear to be [illegible].

Feb. 15, 1907

Culture 91: Tips withered A_1 A_4 A_5 B_1 B_3 B_5 C_3 D_1 E_2
E_4 E_5 F_1 F_2

Culture 92 Tips withered G_3 I_5

Culture 93 Tips withered L_3 L_4 M_1 N_1 P_1 P_3

Feb. 17

In 91 life still alive but disappeared in
B_2 C_1 D_2 D_4 E_3. E_1 is growing.

In 91, withered tips D_3

Feb. 19

In 91 the withered D_4

Feb. 22.

No more tips withered. In 93 there is a
distinct lessening of the purple color
in the old leaves, the plants but are
still most purple showing the least growth.

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF PLANT INDUSTRY,
WASHINGTON, D. C.

Feb. 16, 1909

Calcium Mr. J. F. Breazeale

Calcium, in order to neutralize acids must ordinarily be in the form of

Calcium oxide CaO
" hydrate $Ca(OH)_2$
" carbonate $CaCO_3$

Calcium in the following forms will not neutralize acids

Calcium sulphate $CaSO_4$
" chloride $CaCl_2$
" nitrate $Ca(NO_3)_2$

Mr. Breazeale says that he found ~~that~~ Soils 8, 9, + 11 (the only ones he tried) contained ~~an~~ appreciable amounts of water-soluble calcium, more so than ordinary soils.

Feb. 13, [illegible]

Culture 69, Kalmia. Glass taken off today as the sphagnum under the glass was growing so luxuriantly as to overtop the Kalmia seedlings. The best plants are on the part of the dish covered by glass but without a layer of chopped sphagnum.

Culture 43. The plants are being potted today in 4 inch pots in Sphagnum-Kalmia peat (from the bog) 8, sand 1, loam 1. The plants are lifted from the flat by cutting the soil into rectangular cubes and transferring with the least possible disturbance to the pots. The first 15 plants I potted myself yesterday.

Culture 78. Reserving one plant for a check, I today began to water the other four with a nutrient solution prepared by Mr. Robinson, marked "Normal nutrient, reaction acid."

Culture 79. Same as Culture 78, but solution marked "Normal nutrient, reaction alkaline."

Feb. 18, 1909

Culture 108. Fifty plants from Culture 39, potted in 3-inch pots, without shaking off the original soil unnecessarily, in a soil mixture of Kalmia peat (shaken from the top) 8 parts, sand 1, loam 1. Large plants 5 to 7 cm high, smaller 4 to 5 cm.

Potted by Miss Byrnes Feb. 19, 1909

Culture 109. Same as 108, but soil peat 5, leaf mold (Beach) 3, sand 1, loam 1. Potted by Miss Byrnes.

Culture 106, 107. These were not shaded. They have not withered their tips, nor have the roots made any evident growth. The soil is ~~very~~ amply moist.

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF PLANT INDUSTRY.

EXPERIMENTAL GARDENS AND GROUNDS.

Washington, D. C.,

Feb. 19, 1909

Culture 110. Twenty-five plants, same as Culture 108, but soil consisting of peat 3, mold 5, sand 1, loam 1. Potted by Miss Byrnes

Culture 110A. Twenty-five plants, same as Culture 108, but soil consisting of peat 2 1/4, mold 3 3/4, sand 3, loam 1. This is essentially the same mixture as 110, but with three times as much sand. Potted by Miss Byrnes

Feb. 20, 1907

Culture 111 Twenty-five plants, same as Culture 108, but soil consisting of mold 8, sand 1, loam 1. No peat.

Culture ~~[illegible]~~ 111A Twenty-five plants, same as Culture 108, but soil consisting of mold 6, sand 3, loam 1. Essentially the same soil as Culture 111, but with three times as much sand.

Window sill plants

Of 17 plants on the window sill during the winter, 12 to-day have some of their buds swelling.

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF PLANT INDUSTRY.

EXPERIMENTAL GARDENS AND GROUNDS.

Washington, D. C.,

Feb 22, 1905

Cultures 70. The five pots fed with nutritive solution on Feb 17 showed a distinct greenish color on the surface of the sand on Feb. 20 the checks pot remaining without any such color. The color is due to the development of an alga, apparently unicellular.

B P I

Feb. 23/1909

Culture 41A. A plant, #41 that had made sturdy growth and formed flowering buds during the summer, but since October at least has remained stagnant, though holding its leaves, in the rose house all winter. It has made no growth during the winter. To-day, it was removed from the pot, some of the bottom soil (containing to much loam and sand) taken out to be tested as Soil 20, and part of the top mulch of kalmia peat taken out as Soil 21. The remaining ball was then repotted in a 5 inch pot in peat 6, sand 2, loam 1, and the plant returned to the rose house.

Feb. 28, 1909.

Culture 34. Cuttings removed from the 5 inch pot to-day. (It had been kept under a bell jar.) All were dead except two, these growing well with extensive roots. These were potted in 4 inch pots in peat 6, sand 1, loam 1.

Culture 35. Five cuttings in sand in their original glass pot under a bell jar. All five were alive, and all but one rooted, their roots being short, much branched, and incomplete. These were ~~potted~~ potted in thumb pots ~~in~~ peat 6, sand 1, loam 1, with a bit of peat screenings in the bottom. One was reserved for root examination.

Culture 58. Four cuttings taken out of the glass, all with good roots and growing. These potted in 3 inch pots in peat 6, sand 1, loam 1, with a bottom of peat screenings.

Cultures 33 & 34. Of the cuttings reset and put back in sand on Dec. 2, 1908, two (or three) are dead, three alive; of these 3 one callused, one sparingly rooted, one well rooted.

Feb. 27, 1909

Culture 44 ~~45~~ Forty plants repotted ~~in~~ on Feb. 20 in 4 inch pots in peat 8, sand 1, loam 1.

Culture 45. Eleven plants. Same treatment as 45.

Culture 46 Twenty-three plants same treatment as 44.

Culture 50. Thirty-two plants. Repotted Feb. 25 ~~& 24~~ 4 inch pots, in peat 8, sand 1, loam 1

Culture 47 Fifty three plants. Same treatment as 50

Culture 49. Fifty five plants. Same treatment as 50.

Culture 51. Fifty-two plants. Repotted Feb. 24 + 25 in 4 inch pots in peat 8 sand 1 loam 1.

Culture 52 Four plants. Repotted Feb. 25 in 4 inch pots in peat 8 sand 1 loam 1

Culture 53 Forty-seven plants. Same treatment as 52

Bench space

South end 1 ft 10 1/2 in x 2 ft 6 in.

1 ft 11 in x 2 ft 5 in.

West side 13 ft. 7 in x 2 ft. 9 in

1 ft. 3 in x 2 ft 6 in

East side 24 ft. 1 in x 2 ft 9 1/2 in.

1 ft 3 in. x 2 ft. 6 in.

B P I

Feb. 25, 1908

Culture 35. The rooted cutting reserved for examination has roots of the staghorn type, 1 cm. or less long, ~~and which~~ breaking out of the bark above the callus. No mycorhiza are observed on it. The roots are ~~[illegible]~~ mostly stout and somewhat opaque, but in the occasional clear portions the cell contents are plainly observable. Specimens pressed

Culture 68. The rooted cutting reserved for examination has vigorous, beautifully transparent branched roots, mostly with 5 superficial rows of long epidermal cells, reaching a a length of two inches. No mycorhiza cells are observed after a careful examination. Neither of these two cuttings has made any stem growth. Specimen pressed.

Recut cutting. This shows no mycorhiza. Specimen pressed.

UNITED STATES DEPARTMENT OF AGRICULTURE,

BUREAU OF PLANT INDUSTRY,

WASHINGTON, D. C.

OFFICE OF THE BOTANIST.

Feb. 25, 1909

Culture 54 Four plants, same treatment as 52

Feb. 26, 1909

Culture 56. Eighty plants, potted Feb. 25 + 26, in pot 8, sand; loam

Feb. 26, 1909.

Culture 102. The five cuttings, kept under a bell glass at first, started to push their flowering buds as well as their leaf buds. The bell glass was taken off. To-day two of the cuttings were dug up and examined. Both had a small callus forming at either end of the diagonal cut.

UNITED STATES DEPARTMENT OF AGRICULTURE,

BUREAU OF PLANT INDUSTRY,

WASHINGTON, D. C.

OFFICE OF THE BOTANIST.

Feb. 25, 1909.

Culture 113. This number is given to the plant of Culture 25 that was brought up from the greenhouse several days ago, and photographed.

The last flower on the two buds that have opened thus far was pollinated to-day

Culture 114. This number is given to the plant of Culture 23 that started to grow on the window sill and was brought inside. Feb. 17 ~~few days ago~~.

Culture 115. This number is given to a plant of Culture [illegible] from the window sill that started its buds on Feb. 15 and was brought in yesterday and placed in the greenhouse to-day.

UNITED STATES DEPARTMENT OF AGRICULTURE,

BUREAU OF PLANT INDUSTRY,

WASHINGTON, D. C.

OFFICE OF THE BOTANIST.

Mr. Brazeale Feb. 26, 1909.

Potash

Potassium sulphate, K_2SO_4,
" chloride KCl
Kainit (a mixture of pot. chlor., mag. chlor. etc.)

When potassium sulphate ~~is~~ used as a fertilizer, the potash is ordinarily taken up, leaving the sulphuric acid which renders the soil acid unless lime is used.

Similar action would follow from the other ~~plants~~. fertilizers —

Mr. Bragdale Feb. 27/1909.

Humus, according to the ~~[illegible]~~ official method, is that portion of organic matter soluble in 4% ammonia. This method, however, removes the water soluble organic matter before the ammonia solution is applied.

Soil 26. Hickory willow

Soil 27. Clay loam, used in soil mixtures.

Soil 28. Soil from a stagnant plant of Culture 41

Soil 29. Soil from a growing plant of Culture 42.

Soil 30. Peat roots. Same as 1, but fermented longer.

Soil 31. Peat. Same as 15, but fermented longer.

Soil 32. Peat mixture. From a plant of Culture 19, which was repotted in early December in ~~the~~ a peat and loam mixture. The plant has ~~made~~ flowered and made a slight leaf growth, as well as some root growth but the new root growth does not look healthy nor are the twigs growing healthily.

Soil 33. Soil mixture from our lot, Culture 71

March 1, 1909.

Soil 34. Peat mixture. ~~Used~~ The soil in which ~~the~~ thumb-pots containing the plants of Culture 44 were plunged when they were potted in November, 1908.

Soil 35. Soil from bottom of Culture 113 (a special plant of Culture 25), pure ~~leaf mold~~ peat in the pot since Culture 25 was potted.

Soil 36. Soil from bottom of Culture 114 (a special plant of Culture 23, sand, the surface mulched with peat.

Soil 37 Soil from bottom of Culture 115 (a special plant of Culture 19, which was a good blueberry mixture)

over >

March 11, 1909

Soil 53 From a pot of Culture 79, the manured peat that finally killed ~~the~~ its blueberry plant. (Bacterial sample No. 6)

March 12, 1909

Peat water from barrel started

March 12. Water filtered

Soil 55. From the aquarium culture

56. From culture 105

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF PLANT INDUSTRY,
WASHINGTON, D. C.

March 9, 1917

Samples from [illegible] of the [illegible] only [illegible] as follows

[illegible] 38	Buttonwood	[illegible]	[illegible]
39	"	1	[illegible]
40	"	[illegible]	.4
41	"	[illegible]	Alkaline
42	"	[illegible]	.1
43	"	[illegible]	.2
44	"	[illegible]	.2
45	"	[illegible]	.2
46	"	[illegible]	1.1
47	"	[illegible]	.3
48	"	[illegible]	Alkaline
49	"	[illegible]	.1
50	"	22	Alkaline
51	"	23	Alkaline
52	"	27	Alkaline

March 2, 1907

Culture 113. Plant repotted yesterday in an unglazed liter beaker, 3 cm. of coarsely broken crocks at the bottom, next 3 cm. of peat roots. Then, the ball of earth from the old pot ~~set on peat and~~ pressed against the side of the glass, and the remaining space filled with a mixture of peat 8, sand 1, loam 1.

a layer of sand (peat 8, sand 1, and loam 1) was put in. Put back in my office.

Culture 114. Treated same as Culture 113.

Culture 115. Treated same as Culture 113. Put left in the greenhouse.

UNITED STATES DEPARTMENT OF AGRICULTURE,

BUREAU OF PLANT INDUSTRY,

WASHINGTON, D. C.

March 2, 1909

Transpiration of Vaccinium corymbosum

Began a transpiration measurement experiment with a plant of Culture 75A. The plant is in a 5 oz whiskey glass with a small hole in the bottom. The hole was plugged by rubbing into it a mixture of paraffin (45° melting point) 75%, vaseline 25%. Then the surface of the soil was sealed by pouring over it a layer of the same mixture melted and cooled almost to the temperature of solidification. The mixture solidified almost immediately after pouring and formed an apparently perfect seal of the surface, without injury to the plant.

The main stalk of the plant has a withered tip and is 10.4 cm high, with 19 leaves above the paraffin, the uppermost not fully grown; the lateral branch is 7.0 cm high, with 10 leaves above the paraffin, the uppermost still conduplicate. The lowest leaf of the main stalk is 1.5 by 2 mm., the largest 13 by 20 mm., the others grading rather uniformly between; on the branch the variation is from 1.5 by 2 mm. to 12 by 16 mm.

The weight of the pot at 3:30 P. M. was 171.35 grams.
March 3 3:30 P. M., cloudy 170.86 "
[March 4 cloudy]
5 3:20 P. M., sunny 168.35 "

Glass broken, area measured, 8603 sq. mm.; one surface.

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WASHINGTON, D. C.

March 2 1909

Culture 120. Plant in aquarium grafted to-day, in [illegible] with scions from the Brooks bush ~~[illegible]~~ received Feb. 9, 1909, and since kept in moist sphagnum in a cold frame. The grafting was done by Mr. Gouger, two on branches of matured wood, the leaf buds of which have started to grow, the other on a stolon that has partially hardened wood. The grafting was done with a 3/4 inch diagonal cut, the two parts closely wrapped together with raffia. Live sphagnum was then piled about the base of the plant and over the grafts, till only the last bud of the tip on each scion was exposed to the air. The cut tips of the three scions were sealed with grafting wax.

Culture 121. A plant of Culture 42 from the sphagnum bed grafted like 120, except that

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March 5, 1909.

Transpiration

Branch

Basal leaf	2 mm.	
Second "	7 "	
Third "	21 "	
Fourth "	46 "	
Fifth "	67 "	
Sixth	112 "	
Seventh "	158 "	
Eighth	196 "	
Ninth	106 "	
Tenth	44 "	759

Main stem

Basal leaf	4 mm.	
Second "	6 "	
Third "	7 "	
Fourth "	8 "	
Fifth "	9 "	
Sixth "	24 "	
Seventh "	34 "	
Eighth "	35 "	
Ninth "	32 "	
Tenth "	32 "	
Eleventh "	39 "	
Twelfth "	51 "	
Thirteenth "	90 "	
Fourteenth	102 "	
Fifteenth "	132 "	
Sixteenth "	171 "	
Seventh "	177 "	
Eighteenth "	91	1044

8603 sq. mm.

Mar 6 5 1908

Culture 114. Pollinated 4 flowers on this plant to-day, using each flowers own pollen on its own stigma.

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March 5, 1909,

Cutler's 22 First berry ripened in the greenhouse, one on a plant of this number, fully colored to-day, first class bloom on a dark purple ground. Diameter 10mm. ±

March 8, 1909.

Culture 43. The ~~leafs~~ blades in some of the first
axillary shoots are up to 5.8 cm. in
length and 3.5 cm. in width.

Culture 41 Two plants in 5-inch pots from
the rose house, stagnant since last
summer, brought into the chrysan-
themum house to-day

Culture 41A One pot, brought from the rose
house into the chrysanthemum house to-day,
stagnant since last summer.

Culture 42 One pot, brought from the rose
house into the chrysanthemum house to-day,
stagnant since last summer.

Cultures 103, 104, brought into the rose
house from the propagating house to-day,
all in thumb pots, 104 3 plants, 103 10
plants.

March 9, 1909

Culture 115. No roots started as yet.

B P I

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March 8, 1909

Litmus tests of cultures in the original undrained glass pots potted on May 26, 1908, were started March 6, and came out as follows:

Culture 9. Slightly acid
14. Distinctly acid
17 Neutral
18 Distinctly acid.
19 Distinctly acid (blue at the ends)
20 Distinctly alkaline
21 Slightly acid
22 Distinctly acid
23 Alkaline
27 Neutral

Culture 12, tested to-day is distinctly alkaline.

March 13.

Culture 5 Distinctly acid.
13 Slightly acid.
11 Distinctly acid.
15 Faintly acid

BPI

~~No.~~ 49 | 55

51 | 52
52 | 4
53 | 4
54 | 4

~~Nos. 29~~ 114 In peat 8, sand 1, loam 1 ~~In 44 plunging soil~~

~~115 In 46 & 50 " "~~

~~with 1/10 sand and 1/10~~

~~loam added~~

Mar. 1 115 Peat 7, manure 1, sand 1, loam 1

Mar. 1 116 Peat 9, sand 1, loam 1, bone meal ~~In 49 plunging soil~~

Mar. 9. 117 ~~In 51 plunging soil with 1/10 sand & 1/10 loam added~~

56 | 80
112 | 30
40 | 40

10
5

100
25

125
350

200
125
100
425

Mar. 9. 118 ~~In 47 plunging soil~~

Mar. 1 119 In 44 plunging soil

112 | 1
40 | 9
114 | 25

Ten plants in Peat 8, sand 1, loam 1, with 1% tobacco ashes added (4.25 gr. per liter)

Ten plants in Peat 8, sand 1, loam 1, hickory ashes 1/10% (.425 gr per liter)

122 ~~Fifty~~ Twenty-five plants of Culture 39, in peat 8, (loam 1, sand 1,) potted hard

123 ~~Fifty~~ Twenty-five plants of Culture 39, in peat 8, sand 1, loam 1, potted ~~soft~~

127 Twenty-five, likewise, but very lightly potted

125 Mar. 9. Fifty plants, from 39, in 3-inch pots in peat 7, manure 1, sand 1, loam 1, potted hard with stick.

Mar 9. 126. Twenty-five plants in 3-inch pots in peat 8, manure 1, sand 1

Mar. 9. 127 Twenty-five plants in 3-inch pots in peat 8, manure 1, sand 1, with phosphate meal added (? gr. per liter)

Mar. 10. 128 Twenty-five plants in 3-inch pots in peat 8, manure 1, sand 1 with .04% sulphate of potash (.14 gr. per liter) added ~~(3.5 gr. per liter of manure)~~

Mar. 10 129 Twenty-five plants in 3-inch pots in peat 8, manure 1, sand 1, with .1% bone meal and .04% sulphate of potash added.

(.35 gr. bone meal per liter)

March 10, 1907.

Culture 130. Six plants of Culture 49, in 4 inch pots, set aside and watered with lime water (1.25 gr. calcium carbonate per liter). These plants are of the following heights

9 cm.
11 "
13 "
12 "
11 "
13.5 "

50 c.c. each pot today

Two liters of this water will bring the lime fer ~~ent~~ up to about 1%

Culture 41. Two plants, one in the Magnum, one from the rose house lot (brought to the chrysanthemum one a few days ago) watered with 150 cc. of 1/20 normal citric acid solution per each 5 in. pot. Plants marked 'citric'

March 11, 1908.

Pollination.

On a few bushes berries that were not pollinated by hand are holding on, and growing. These differ from ~~the~~ hand pollinated berries by the fact that the upper surface of the ovary, within the calyx, is conspicuously convex, while in the hand pollinated berries this ~~growth~~ surface is concave.

Cutting 37. The remaining 4 cuttings of this number are discarded to-day. One was dead throughout, one dead below, and two were alive throughout, though none bore leaves.

March 13, 1908.

Culture 130.

Watered to-day with 50 cc. limewater each.
March 13, 1908

" " " " " 2. more March 13, 1909

Remove all plants. The buds have now started on 12 out of fifteen plants as follows

2 a
6
15
18
22
24 (mulch-rooted plant)
25
29 a
29 b
30 b
31
41

Those not started are

2 b
17
24 (non-rooted plant)

In none of these (except possibly in 2 a 2 b & 41, which are in stone, not porous, pots) is there any evidence whatever of root growth.

Culture 113. ~~[illegible]~~ No root growth yet. Flowering completed, first green growth with the long ago visible, new buds on the old wood, starting to grow.

March 12, 1909.

Culture 120, 121. All four grafts in good condition, the wood fresh and plump and one or more buds pushing on each graft.

[illegible] 14, 1909.

Cultures 131. Acidity tests of soils as follows: Five inch pots

131 A Pure peat, light
131 B Pure peat, hard
131 C Peat 8, sand 1, loam 1, light.
131 D Peat 8, sand 1, loam 1, hard
131 E Peat 9, sand 1, light
131 F Peat 9, sand 1, hard
131 G Peat 8, manure 1, sand 1, light
131 H. Peat 8, manure 1, sand 1, hard
131 I Peat 4, sand 3, loam 3, light
131 J Peat 5, sand 5, light

Samples are to be taken at intervals of a month and tested for acidity, to ascertain the relative efficiency of these soils to maintain acidity.

Not used

B P I

March 13, 1907

Culture 127. In every pot of this number ~~a~~ a mold occurs in quantity. It is now in bunches, associated with the patches of bone meal. Many of the bunches have already fruited.

Culture 114. Almost every plant shows some degree of puckling in the old leaves, and 21 out of 25 plants have withered their tips.

Culture 115, which differs from 114 in having one tenth manure, has leaves much less conspicuously puckled, many of them not at all. ~~not~~ Unfortunately this lot of plants was badly selected, as ~~15~~ 20 out of 25 have been affected by the mite that crinkles the leaves; in 114 none of the plants had the mite. In ten of 115 however, the tips are not withered.

Ripe berries. Two more berries, making 3 altogether, are now ripe in the greenhouse, [illegible] one on a plant of [illegible], one on a plant of 11. All are of the 10–11 mm. class.

Culture 120. Principal buds on each of the tips range 5.5 to 7.5 mm long.

March 13, 1909

Culture 15. Two plants from the four in the greenhouse watered to-day for the first time, with peat water from the bank. Plants marked "peat water". No one of the four plants has started a bud though the wood is in apparently sound condition.

Culture 29. Began to-day to water with peat water two plants from the four in the greenhouse lot. Both have a small new growth but the leaves are pallid.

Mar. 14, 1909.

Culture 78. The five plants that were watered on Feb. 17, Feb. 25, and Mar. 6 with an acid nutrient solution now show distinct signs of growth. The two plants that never withered their tips are putting out new leaves of increased size. Of the other three plants one is putting out a new basal shoot, while in the two others the bud in the uppermost axil is pushing. In the check plant the buds are stagnant.

March 13, 1909.

Culture 132. Tests of the acidulation of neutral soils. Five-inch pots as follows

132 A ~~Peat~~ Leaf mold

132 B Loam.

Water with peat water, ~~measuring~~ testing the acidity before ~~and~~ watering and as the watering goes on.

March 19, 1901.

Culture 79. Of the five plants [illegible] with a slightly alkaline nutrient solution on Feb. 17, Feb 25, and March 6, one is dead or nearly so (it was in bad shape when the watering began), the [illegible] the stems till never withered [illegible] three very small leaves at the top, and the other two have dormant buds as [illegible] the buds.

Culture 91. Good growth has now begun on all the plants in this culture, and the puffing of the old leaves has disappeared in all but two of the plants

Cultures 92 + 93. Good growth has continued in both cultures, 93 showing a little better than 92, and both being far superior to 91

Cultures 64 + 65. The plants of Culture 65 average a little larger than those of Culture 64.

Culture 67. Top growth has taken place in two of the four plants. The others do not seem to grow.

Culture 67 A. Three of the five have made top growth [illegible] but [illegible] in 67 + 67 A. Root growth was [illegible] 67 A is distinctly poorer than in 67.

March 15, 1909

Spores

On March 11 while examining the roots of a plant of Culture 76 for mycoriza, the large spores first observed in a plant of Culture 5 on May 5, 1908 (see also May 16, 1908, in a plant of Culture 4), were found in abundance. Roots of the same plant examined March 13 and to-day were also found to contain an abundance of these spores. The roots were abundantly supplied with mycoriza cells gorged with mycorhiza. The spores like the mycorhiza occupied the epidermal cells only, usually a single one in a cell, occasionally two. Although hundreds of spore cells were examined none (except in one doubtful case) contained any evidence of a mycorhiza knot.

Most of the spores were of the pitted, double-sphere type described in 1908, with granular contents, the sides of the optical star having 6 7 8 or 9 sides in all

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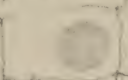
Spores (con., 2) Mar. 15, 1909

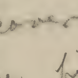
the cases counted

b 

In a few cells were found spores a little smaller size with only a single membrane and the contents granular. These are probably a younger stage of the spores.  a

Apparently intermediate stages occurred.

In a very few cases the granular contents of the spore was somewhat contracted the double surface covering thicker than usual and the pit markings almost obsolete

 c

This appears to be a stage in the development of the spore prior to that next to be described.

A few cells contained spherical bodies, apparently spores,

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Mar. 15, 1909.

Spore (con., 3)

which had a single-membraned thin wall, and hyaline interior, as if the contraction of the granular content as shown in figure c had been completed and the fat-markings had disappeared entirely.

d

In one case one of these hyaline spores had developed a distinct but short hypha

e

The material examined to-day, on which most of the observations were based, was detached from the plant and washed on March 11, and kept since in water. One fragment has been in a moist cell since March 11.

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March 15, 1909

Culture 120. Uppermost buds on the [illegible] grafts 8 to 10 mm long.

Culture 110. No new roots from the plant yet, though new ericaceous rootlets 2 to 3 mm. long have been thrown out from some of the ericaceous roots in the mass of coarse kalmia peat in the bottom of the beaker. This peat was gathered in November, 1908. All the earlier ~~leaves~~ branches that developed since the plant was brought indoors, eighteen in number, have withered their life. The longest of these has an axis of 17 mm. and 11 pairs of bracts and leaves. Other branches are beginning to grow, and ~~new~~ additional ones [illegible].

Culture 66. ~~One of the~~ The two plants in glasses have made very large root systems. One has developed a branch of 103 mm. length. The other has developed only short branches (10 mm axis or less), but has formed three flowering buds which are now pushing [illegible] the flower buds swelling.

March 17 1908

Cultures 30 [illegible] with 2 g. lime water each.

March 18, 1908

Each 50 cc. lime water.

March 21

Each 75 cc. lime water

March 23

Began on second bottle of lime water giving each about 50 cc.

March 24

Each 50 cc lime water.

March 26

Each 50 cc lime water. No [illegible] growth as yet. Plants growing vigorously.

March 27

Each 50 cc lime water

March 29

Each 50 cc lime water.

April 1

Each 50 cc lime water

April 2

Each 40 cc lime water

April 3

Each 40 cc. lime water

[illegible] 5 1908

Each [illegible]

Cultures 30 April 7

Lime water 50cc. each

April 8

Lime water 50cc. each

Apr. 9

50cc each

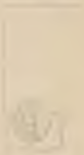
March 17, 1917

Spores
Ginkgo mycorrhiza

The many [illegible] thick-walled pyriform spores
were found in one plasmolyzed cell of the Ginkgo
root yesterday.

In a root taken from a plant
of cuttings [illegible] to-day, the same
plant from which roots were taken
on March 17, were many spores
in the ordinary [illegible] form and
in phases of [illegible] plasmolysis. Thin walled
[illegible] spores containing [illegible]
and bodies [illegible] to the [illegible] of
the [illegible] itself. Several were seen
to have put out a germination
tube and in one case the tube [illegible]
seemed to pass through the wall

of the epidermal cell of the host. The preparation was not however entirely satisfactory. The appearance presented was as shown



If the tube went through the wall of the host the tube was open at the end. There was a vacant space in the spore at the base of the tube.

Some of the germinated spores were found out of the root by pressing on the cover glass. They were lost however in subsequent manipulation.

BPI

May 6, [illegible]

Watering the [illegible].

The considerable amount of [illegible] ling of old leaves has taken place recently in ~~[illegible]~~ the plants potted a few weeks ago in small pots from the [illegible] [illegible]. These include Nos. 43, 44, 45, 46, 47, 49, 50, 51, 52, 53 [illegible] [illegible] there is a [illegible] [illegible] ([illegible] 54 and 55) [illegible] [illegible] [illegible] through these plants [illegible] the same [illegible] [illegible] as the [illegible].

The [illegible] is [illegible] to the effect [illegible] [illegible] the [illegible] [illegible] [illegible]

[illegible] [illegible] [illegible] [illegible]

[illegible] [illegible] [illegible] [illegible]

[illegible] [illegible] [illegible]

[illegible] '97

Culture 55. Planted [illegible] tube of [illegible] gelatin [illegible] [illegible] the [illegible] from the [illegible] 55 [illegible] of first & second [illegible]

Culture 55 A. Twenty-seven flasks [illegible] of flask 55, [illegible] [illegible] of [illegible] of second [illegible]

Culture 55 B. Twenty five flasks from flask 55, [illegible] [illegible] few [illegible]

Culture 41 [illegible] - [illegible] [illegible] [illegible]

Culture 41, citric acid; [illegible] of the [illegible] flask 75 cc [illegible] nitric acid [illegible]

Nov 16 = 9/1909

Culture 46. The second plant of this lot examined today. The roots are [illegible] with internal mycorhizas, [illegible] surface [illegible] with hyaline hyphae [illegible] apparently [illegible] the [illegible] mycorhizas.

None of the [illegible] [illegible] have been found in the [illegible] [illegible] [illegible] examined. Plant placed in [illegible] with fresh water.

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Culture 75 March 29, 1909

Examined the roots of a feeble plant of this culture. No resting spore no intracellular mycorhiza. On a few roots an septional fungus, possibly a mycorhiza fungus.

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March 22, 19[illegible]

Soil 57. Peat water, from the bog

March 22, 19[illegible]

Soil 58. Peat water, from the [illegible]

March 2[illegible]

Soil 59. Loam, from the field in use of the Department greenhouses. Sample taken from [illegible] L[illegible] which the seedlings for test started March 25 was begun.

Soil 60. Sand, washed, from that used for [illegible] for the blueberry [illegible]. From the lot used for the [illegible] test started March 25.

Soil 61. Leaf mold, from [illegible]. Prepared for the inoculation test.

Soil 62. [illegible] wood, from [illegible] by [illegible] in [illegible]

Soil 63. Manure water, from the cow [illegible] of the Department, used in forcing roses etc.

April 3, 1919

Soil 64. Soil from a plant of citrus 75 sand watered with an acid nutrient solution; Alkaline!

Soil 65. Peat water from the peat barrel Titrated 15 cc per 200 cc. or ~~[illegible]~~ % normal

Soil 66. Loam, 1 liter watered with 500 peat water daily since [illegible]

Soil 67. Sand [titrated as 66] — [illegible] normal [illegible]

Soil 68. Leaf mould [titrated as 66] — [illegible]

April 8, 1919

Soil 69. Peat water from the [illegible]

Soil 70. Nutrient solution (acid), [illegible] for Culture [illegible] 200 cc. [illegible] (or [illegible] % normal)

Soil 71 Nutrient solution (with [illegible]) [illegible] for Culture 87

April 15, 1919

Soil 72. Peat from a pot of Culture 90 which has recently purpled. The ball of peat when knocked out of the pot has a sour offensive odor like that of a pig pen. Titration 20

Soil 73. Peat from a pot of Culture 90, which has not yet purpled, but is growing well, possibly due to receiving more shade than the other pot. Same offensive odor. Roots growing out of top of soil. Titration 2.2

March 22 1909

Culture 120. Bud on one graft grown to short leafy branch 2. cm. in length. One 16 mm., one 9 mm.

Culture 77. Citrus with plant in the greenhouse bed with several leaf-falls. Finishing the flowering buds [illegible] flower buds half grown and white.

Culture 65. The plant with flower buds nearly mostly open. Some [illegible] thus making with ~~the~~ one number of fairly well set fruit.

Culture 115. No new roots yet but top in healthy condition. Of the second set of new shoots one is 4 cm long and still growing.

Culture 15: Repotted in [illegible] boxes, four plants, in four boxes [illegible] with an inch of coarse [illegible] in the bottom and [illegible] above the [illegible].

March 23, 1909.

Window sill culture. The last of the 15 plants on the window sill have started to push their buds. No new roots are yet evident.

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March 2[illegible], 1909

Culture 120. One of the flowering buds is withering at 9 mm.

Culture 132. This number is given to the plant of Culture 66 in a grafted glass glass pot, a cutting of October 15, 190[illegible], which was mulched with peat on March 22. The first flower ~~[illegible]~~ opened this morning.

March 25, 1909

Culture 94. All six plants have resumed growth, chiefly by basal shoots. There is no green growth on the soil surface.

Culture 95. All six plants are red-purple and making practically no growth. Basal buds have formed but are standing almost still. Moss plants are forming abundantly from the green covering of protonema on all the pots.

Culture 96. In all six plants growth has been resumed. The purple color of the leaves has mostly disappeared. There is no green growth on the soil.

Culture 97. The plants are still purplish and most of them stagnant. No green growth on the soil.

Culture 98. Plants beginning to grow. Color only slightly purplish. No green growth on the soil.

Culture 98. Plants fed with acid nicotine solution all growing. Looks red-purple are stagnant.

Culture 99. Plants fed with alkaline nicotine solution, one [illegible] dead, the others [illegible] stagnant and somewhat purplish. The [illegible] red-purple + stagnant

March 25, [illegible]

Culture 41A making good new root growth, but the wood and buds are entirely dormant.

Culture 114 The purpling of the leaves is becoming and growth has begun

Culture 115 + 119. The leaves have remained green or only slightly purple and considerable growth has taken place. Green algae on 115 + 119, + 123, not on 114, 122 128.

Culture 122, 123. Some of the plants, beginning to ~~recov~~-~~ering~~ from their purpling and growth beginning.

Culture 124. Leaves not so purple as 122 + 123.

Culture 125 About the same condition as 122 + 123

Culture 126. No green growth

Culture 127. Green algal growth like 116

Peat water
First titration before fermentation 3.5 cc.
Second " March 22 11 cc.
Third " " 25 12 cc.

March 2[illegible], 19[illegible]

[illegible] 132. First flower pollinated to day with its own pollen.

March [illegible]

Second flower pollinated to day with its own pollen.

April 3, 19[illegible]

Pollinated a fifth flower to day.

April 5, 1907.

Pollinated a sixth flower to day.

April 6, 19[illegible]

Pollinated a seventh flower to day.

April [illegible]

Pollinated the eighth flower to day.

March 25, 1907.

Culture 29½. The first new root growth on any of the ~~glass potted~~ window sill plants shows to-day in this plant.

Culture 31. Plant trimmed back to stubs today, four stems being cut off of the following lengths. 7.3 cm., 16 cm., 20.9 cm., and 31.1 cm.

Culture 30. Plant trimmed back to stubs to-day, the longest branch being 30.1 cm.

Culture 41. The window sill plant of this culture, in a 5 inch pot, now has 66 buds started, 4 of them being flower buds, and the longest of the leaf buds being 7 mm., yet no root growth has yet taken place.

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BPI

March 24 1909.

Cutting No 3. Fifty-six cuttings from the Brooks bush received from Raffle [illegible] yesterday were put in a (for me) sand bed with bottom heat and covered with glass to-day.

March 26, 1909

Culture 115. The first new root growth in what was originally the peat mulch of the pot 19 in culture are seen to-day. One is 13 mm the other .8 mm long.

Sphagnum bed plants. All the plants have started except one plant of #2 and the first water plant of #1.

March 25, 1919.

Mr. Will F. S. Banks of Grand Junction, Mich. visited the blueberry house to-day and gave the following information.

He has been grafting and cultivating huckleberries for about 11 years.

He cultivates them just like corn.

His best bush produced last year two crates of 16 quarts each, which he sold in Chicago about July 1 for $11.00

His berries are as big as [illegible], or as big as 2 or 3 of the [illegible] berries he was looking at. On exact inquiry, his berries, he stated, were one half an inch but about a third of an inch in diameter.

His berries are of the black type and he has had no success with the blue ones, either in hybridizing or grafting.

He grafts his large huckleberries on the roots of the [illegible], a bush about 10 feet high with black glossy inedible berries and a flavor like that of the huckleberry but larger. He said his grafted plants about 8 in. high and they bear right above the graft.

On close inquiry he stated that he had 12 grafted plants.

He has sold a large number of seedlings. He did not state the exact number.

(over)

His method of crossing plants is to tie two flowers together over night, he has not had success in transferring pollen.

His greatest success in cultivating has been in a spot in a drained bog where the soil is so alkaline that weeds and other plants will not grow.

Upon my suggestion that I would like to see his plantation of huckleberries, Col. Banks said that he would be glad to see me then and to show me the plants. Afterward he declared that the best time to see the plants would be in the fall after the leaves were shed, when the land would be clean and the plants in good shape for comparison.

April 2, 1907

[illegible] 113, Several new roots to-day

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BUREAU OF PLANT INDUSTRY,

WASHINGTON, D. C.

March 27, 1909

Culture 115. Several new roots 2 to 3 mm. long to day.

Culture 67. Planted five young [illegible] in thumbpots in the same sphagnum to day and on the 26th.

Culture 134. Thirty five plants (Kalmia latifolia) from Culture 67 transplanted March 25, 1909 into a flat at a distance of 2 1/2 inches from each other in a soil of peat 8, sand 1, loam 1.

Culture 135. Twenty seven plants of Kalmia latifolia from Culture 67, transplanted March 26, 1909 into thumbpots and plunged in sphagnum. Soil of peat 8, sand 1, loam 1. In this culture and the last the plants have all 5 to 7 leaves besides the cotyledons, almost in a rosette, the leaves rising hardly more than 5 mm from the ground and spreading 10 to 15 mm.

Culture 120. In [illegible] pots one has [illegible] and [illegible] [illegible] [illegible] begun to [illegible] [illegible] [illegible]. In one pot the [illegible] [illegible] [illegible] the [illegible] [illegible] grown [illegible] [illegible] of 1 cm [illegible] [illegible]

apex and leaf length being 3. cm. The branch on the other graft is still growing. In both the leaves are yellowish green.

Of the two stolon shoots recently made by this plant one is forming a terminal bud at 22 cm from the moss, being 3.5 mm. in diameter at the moss and having produced 42 leaves above the moss. The other is 28 cm long from the moss, 3.5 mm. in diameter at the moss, has 50 leaves above the moss, and has lost the tip by browning to-day.

With bud graft no cambium growth took place on either stock or scion, though the stock is still alive.

March 30 1909

Asparagus plants. Cut off last years stalks. Plants have remained alive but dormant for at least six months.

Ripe berries. Picked six ripe berries of the 1907 plants in the asparagus bed today. Six ripe berries were left on. Some have been stolen in the last two or three days.

Leaf Blight. Still [illegible] to [illegible] today a plant of 47 and one of 19 affected with a brown leaf spot disease.

Cuttings 133. Flowering buds and a few of the leaf buds swelling to-day.

Cuttings 132. Each of these cuttings removed. They had made a slight callus but no [illegible] from the base.

[illegible]

Plants have been separately [illegible] from several breeding places to the [illegible] in the bed for keeping a [illegible] (Cultures 21, 25, 26-28 [illegible])

Culture 17. Two plants, formerly in the [illegible] in fruit. None of these plants has [illegible]

Culture 18. Two female, formerly in fruit. [illegible] in fruit.

Culture 23. Three plants, formerly [illegible] and [illegible] with [illegible] [illegible] with [illegible] [illegible]

Culture 24. Two plants formerly [illegible] [illegible] in fruit.

Culture 25. Two plants formerly in fruit [illegible] with fruit. [illegible]

Culture 26. Three plants formerly [illegible]

[illegible]

Berries. One of ~~7~~ the plants of Culture — the [illegible] now has two 11-12 mm berries

Culture 115. Plant now with many new leaves,

April 2, 1907

Culture 47 A Gave this number to the southernmost 4 rows of Culture 47, 26 plants. Watered them with about 500cc of cow manure water from the tank. The remaining 26 plants of Culture 47 will be untreated.

April 2, 1909

Culture 136 Two short cuttings, received from the Brooks farm Feb. 9, 1909, and since kept dormant in moist sphagnum, were recut to-day and submerged horizontally in the ~~[illegible]~~ growing sphagnum of Culture 69

Manure water titrated after boiling .4 cc.
before boiling 4. cc.

April 5/1909

Culture 120 A. The middle plant in the aquarium is given this number to-day.

Culture 120 B. The plant in the aquarium grafted with Vaccinium [illegible] is given this number. The graft looks in good condition, but the buds are not yet growing. The shoot grown during the winter [illegible] up is 40 cm. high from base [illegible]. The uppermost five [illegible] buds are now differentiating as flowering buds

Leaf spot. A plant of 55 B and one of 53 affected with leaf spot to be turned over to Dr. Smith (Erwin F.) to-day.

April 3, 1909

Culture 53. Flowering buds opened sufficiently to show the flower buds. A few of the leaf buds a centimeter in length, on some cuttings badly started.

Culture 54. A few of the plants show a moderate puffing of the old leaves. Several show purple mottling.

Culture 55. A few show puffing, a few purple mottling, the latter associated apparently with old red spider work.

Culture 53A. A few show purple mottling, partly from red spider work partly not.

Culture 131. No puffing as yet.

Cultures 116 and 127 with a thick shining green layer of algae, conspicuous among the cultures in 3 inch pots 114 to 119.

Professor Munson. Mr. May the gardener who did most of the potting says that Col. Brackett and Prof. Munson called at the greenhouse yesterday, and that Mr. May answered all he could of Professor Munson's inquiries in regard to the soils used in potting.

April 5, 1909

Culture 115. Some of the new roots are at least 12 mm. long. The second set of new branches are not losing their tips. One of them is 6 cm. long, another 5 cm.

Culture 15. New root growth is taking place in all the four beakers, though the buds are ~~[illegible]~~ badly [illegible].

Culture 18. Root growth in all especially in one rapidly growing plant.

Culture 23. Root growth good in all, very vigorous in one plant that had made new growth and stopped before transplanting to the beakers. New roots at least 10 mm. in one case.

Culture 24. Very slight new root growth

Culture 25. New root growth up to 5 mm. in one of the beakers

Culture 26. New root growth in all up to 2 mm.

Culture 28. New root growth abundant in two, up to 5 mm., these plants having made and stopped new growth during the winter. Two shows no new [illegible] & [illegible] growth.

April 15, '09.

Culture 67. One plant has made no growth from the original cutting, and ~~[illegible]~~ not very large root growth.

One plant has made three good branches, the longest 7.5 cm long, all with tip withered and wood now ripening.

Two plants ~~have~~ are making a long branch (still growing) ~~[illegible]~~ from a lower bud, and the original flowering buds on the cutting are pushing their flower buds.

Culture 68. Two plants are making what appear to be flowering buds on their ripening branches.

Culture 41A. The first sign of stem growth is the pushing of a green tip from a basal bract of one of the flowering buds.

Ripe berries. The 1907 plants in the sphagnum bed now bear 16 ripe berries.

Culture 137. Six cuttings from Culture 44, made from tips of ~~two~~ branches, placed ~~horizontally~~ in the growing sphagnum of Culture 69. Three of the cuttings wholly submerged and with [illegible] leaves but for those with the tips out and 1 or 2 leaves left on.

April 6, 1908

Culture 121. The growing bud on this graft has withered and died. In removing the graft it was found that a union with the stock had taken place at the base of the cut surface of graft, ~~but that~~ it was evidently insufficient to furnish nourishment to the scion.

Ripe berries. Nineteen ripe berries are on the 1907 plants in the sphagnum bed

Culture 138. Forty plants of Kalmia latifolia, from Culture 69, potted yesterday in a flat at 2 1/4 inches in pure kalmia peat.

Culture 139, Twenty-eight plants of Kalmia latifolia, from Culture 69, potted to-day in 2-inch pots in pure kalmia peat, to be plunged in live sphagnum

~~Them~~ April 6, 1907.

Photographs to be taken

Culture 140. Two one [illegible] size one-third
Culture [illegible]. One, one-third natural size.
Culture 57. Calmia [illegible]

~~Three~~ two natural size, one enlarged

Culture 88. [illegible]
Two pots on one plate, natural size

Culture 67. Cuttings
Two pots, one with flowers, one not, to be
photographed when the flowers form.

Culture 71-73.
Photograph of whole bay.

Culture 73
One natural size

Culture 75
One natural size

Culture 76
One natural size

Culture 77
One natural size

Culture 78. ~~Three~~ [illegible] two others
Culture 79. Two, [illegible].
Culture 80. One
81. One ~~[illegible]~~

Photographs taken [illegible]

April 2, 1918.

Culture 78. Two plants watered to-day with fresh water, one 6.0 cm high and with a branch 2.7 cm high, the other [illegible] cm high with a branch 3.3 cm high.

One plant watered with citric acid, 4.5 cm high. The new growth on this is exceedingly [illegible], as in culture 77.

Cape [illegible]. Picked 16 ripe berries from the [illegible] [illegible] plants. ~~The~~ largest being [illegible] was [illegible] ~~yes~~ yesterday. Two of these picked were [illegible] ripening [illegible]. They look little [illegible] [illegible]

Distillation of soils.

To-day took out a sample of each of the three soils that have been given 500 cc of fresh water per day since March 25, [illegible] [illegible] [illegible]

Culture 85. abundant ~~[illegible]~~ growth of roots all over the ~~[illegible]~~ surface by the old little plants grown [illegible] during the winter.

BPI

April 8, 1909

Culture 57. One of the plants of this culture, in less than eight months from the time of planting the seed, has made a flowering terminal bud from [illegible] a young shoot in the axil of the [illegible] first basal branch [illegible] on a ~~one of the lower bracts~~ subtends an actual flower bud as determined by dissecting it.

Two other plants of the same culture have developed buds that appear to be flowering buds. They occur on first basal branches, in the uppermost axils, being [illegible] with a second similar bud in the next lower axil also.

Other plants in [illegible] appear to be producing flowering buds, but the cases are not easy yet, first plant [illegible] doubtful producing a terminal [illegible]

Culture 43. [illegible] a 1 cm. branch from a flowering bud on the uppermost axil of the first basal branch of the plant. No [illegible]

Culture 1204. The flowers pollinated on this [illegible] next branch growth [illegible] The plant is now making general ~~[illegible]~~ growth and has but [illegible] flowers two of which are pollinated to-day; marked with two cut [illegible]

April 10, 1907

Culture 120 B. The layered branch that was severed from the plant several weeks ago, and which dropped its leaves shortly afterward, is dead. It had developed a large callus at the slice ~~point~~, and fair root growth, but nevertheless was unable to pull through.

The *Vaccinium parvifolium* graft is uniting and its buds are dormant

Culture 123. Grafts growing satisfactorily, one with 5 leaves, including the green bracts, the other with 6.

Cuttings 133 April 15, 1907

One of the cuttings dead and removed yesterday. Eleven of the cuttings in flower to-day, the flowers nearly cylindrical. Some cutting with shoots up to 3 cm long, and as many as 7 green, veined bracts and leaves.

Smithsonian Dwelling bushes. In flower, the leaf buds grown to about the same length as the ~~flower tubes~~ [illegible]. Flowers 5 to 7 mm long, greenish or pinkish white. Leaves pubescent on the backs.

April 16, 1909

Culture 140. This is the number given to the window sill plant of Culture 41. The first flowers are open this morning, in a nine-bud raceme.

The new branches have made good growth, some of them being 3.5 cm. long. Fifty-five leaf buds on this plant have actually grown on this plant and four flowering buds. One flowering bud and two leaf buds have swollen but have not yet developed any growth.

Plant knocked out of the pot this afternoon. The soil broke in two at the base of the old root ball, and the roots were clearly seen not to have started.

Apr. 19, 1909

Eleven flowers are out to-day, and two have flowered and been picked off probably by birds.

April 20, 1909

Twenty-three flowers out to-day. Longest new branch 5.5 cm.

Apr. 21, 1909

No more flowers out to-day. No sunlight.

Apr. 22

Sunny, 26 flowers open.

Apr. 23

Cloudy, 26 flowers open —— (over)

(Over)

UNITED STATES DEPARTMENT OF AGRICULTURE,
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WASHINGTON, D. C.

Apr. 24

Twenty-seven flowers out to-day. Pollinated twenty-six, one being broken off accidentally. Six corollas were detached, the flowers being probably too old to pollinate; the styles however remained on.

The plant was knocked out of the pot and the surface of the original ball examined, but no new root growth has taken place. The apex of one of the

Plant photographed to-day and Apr. 20

new branches is 3.5 cm long, and with its leaves reaches 60 cm. Its tip has not withered. Twenty-seven ~~new~~ branches on the plant have grown the, several of them however showing a reduced leaf rudiment evidently preparatory to withering. See note on 41 A, this date.

April 17, 1907.

Sugary secretion from glandular hairs on the backs and basal margins of leaves. This occurs to-day on plants at the office as follows:

Culture 140
Culture 29 b
Culture 29 a
Culture 15
Culture 6
Culture 2 b
Culture 2 a
Culture 113
Culture 114

Of these plants all except 2 a + 2 b are [illegible] have [illegible] new growth, and these two are believed not to have any.
All these plants are growing chiefly on stored food

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April 17, 1919

Culture 56A. Forty-four plants of Culture 56 began to be watered to day with manure water from the manure pit, leaving 36 plants in Culture 56.

Culture 47A. Watered with manure water April 2, 10, 17. The new shoots on these plants appear to be more vigorous than those in Culture 47.

Culture 56. Growing tips 60 on the 36 plants, of these 19 over 10 cm. long, 21 over 20 cm. long. [illegible]

Culture 56A. Growing tips 115 on the 44 plants, of these 22 over 10 cm long, none over 20 cm. long.

Culture 47A. Growing tips 49 on the 26 plants, of these 22 being over 10 cm. long.

Culture 47. Growing tips 52 on the 26 plants, of these 16 are over 10 cm. long.

April 17, 1919.

Smithsonian bushes. In full flower, many of the buds not yet opened. Glands on the midribs and leaves in many cases giving a clear syrupy [illegible]. Stumps one unfruited trunk 8.5 cm. in diameter. One living trunk 21 cm in circumference. Tallest [illegible] [illegible] 7 to 10 ft high.

April 19, 1909

Culture 133. Ten cuttings examined today, partly blackened, of these 5 had no callus, 5 a small callus

Culture 89. Repotted in 4 inch pots, April 16. in pure kalmia peat.

Culture 90. ~~Repotted~~ in 4 inch pots April 16, in pure kalmia peat.

Culture 64. Transplanted from the flat into 4 inch pots in peat 7, sand 2, loam 1, on April 17, 31 plants

Culture 65. Transplanted from the flat into 4 inch pots in peat 7, sand 2, loam 1 on April 17 twenty-two plants after taking out 65 A. Growing tips 35, 10 cm.

Culture 65 A. Twenty plants taken out of Culture 65 and watered occasionally with manure water, beginning to-day. Growing tips 35, 9 over 10 cm long.

BPI

April 20, 1909

Culture 13. Plant showing some new roots, evidently ~~a~~ a week or more of age.

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April 20, 1909.

Wilting point of Vaccinium corymbosum.

The plant of Culture 89 recently photographed stood without watering and to-day when its leaves were withered but still flaccid, a test of the soil moisture was made. ~~With it~~ The soil was broken away from the plant and crumbled into a beaker. The soil and beaker weighed 149.82 grams.

Apr. 21, 1909

Weight to-day, after drying in air 146.85

Apr. 23, 1909

Same 145.35

Apr. 27, 1909.

Weight to-day, after drying in an oven at since April 23. 143.8

Weight of beaker 127.73

Water therefore 37% of the soil weight

Apr. 23, 1909

Dr. Shantz determined the moisture in another sample plant on [illegible] (Culture 79) at the wilting point as 74 %.

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April 20, 1909

Culture 31. Plant repotted to-day in a liter beaker in pure kalmia peat. No new roots yet, the leaf buds ~~[illegible]~~ growing, the largest 1 cm. long.

Culture 18, window sill plant. Repotted in kalmia peat in a liter beaker to-day. No new roots yet, the last year's growth profuse. New branches 3.6, 3.3, 3., and 1.8 cm long

~~3.6 1.8~~
3.3
3.0

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April 20, 1909

Cutting 43. Took out six plants for [illegible] best without ~~[illegible]~~ will give ~~[illegible]~~ formation of flowering buds.

Whenever [illegible] with	No [illegible]
A 3	B 5
G 1	B 4
F 4	D 3
C 4	D 1
H 4	H 5
I 2	G 5

All these plants ~~[illegible]~~ have a [illegible] fleshy tendency, and [illegible] from showing tendency to [illegible] or stalling in the [illegible].

~~[illegible]~~

These branches which have [illegible] their wood, show little tendency [illegible] + G 5 making of flowering buds, [illegible] the [illegible] and first [illegible] the [illegible] ments on [illegible] wood.

Measurements of plants as follows:

B 3 Two [illegible] branches, 17 cm.
One soft branch, wilted, 5.5 cm.
2 soft branches, growing 6 + 15 cm.

H 1 Two [illegible] branches 15.5 + 20 cm.
Five soft branches, growing, 4, 3, 8 and 21 cm

F 4 One [illegible] branch, 18 cm
One [illegible] branch, 22 cm
Four soft branches, growing 5, 4, 9, 25 cm
([illegible])

B_4 One maturing branch, 18 cm.
One soft branch, growing, 8 cm.

F_4 One ripened branch, 16 cm.
Two soft branches, [illegible] 24, 15, 18, 12 cm.

I_2 One ripened branch, 8 cm.
Three soft branches, growing, 9.5, 16.5, 1.2 cm.

No fertilizer plants, as follows:

B_5 One ripened branch 19 cm.
Three soft branches, 2, 12, 2.5 cm.

B_4 Two ripened branches, 15, 21 cm.

D_3 One ripened branch, 12 cm.
One maturing branch, 20 cm.

D_1 One ripened branch, with flowering bud in afferent apil, 13 cm.
One maturing branch, 20 cm.

M_5- One ripened branch, with maturing continuation, both together 21 cm.
Three soft branches, withered, 15, 12, 11 cm.

G_5- One ripened branch, with maturing continuation, together 14.5 cm. The afferent axil has a flowering bud.
Two soft branches, growing 18, 10.5 cm.

April 20 / 909.

Culture 72 A. Thirty-five plants out of the seventy in culture 72 are taken out and made into 72 A. The plants are so selected that the number and length of growing shoots is as follows.

Culture 72, 92 shoots, 36 of them over 10 cm. long, 6 of the 36 over 20 cm. long.

Culture 72A, 92 shoots, 36 of them over 10 cm. long, none over 20 cm.

Culture 72A will be watered at intervals with manure water to beginning to-day

Culture 47. Growing shoots over 20 cm. long 21

Terminated shoots over 20 cm. long 10

Culture 47A Growing shoots over 20 cm. long. Terminated shoots over 20 cm. long

Culture 45 Out of 11 plants, 6 have made flower [illegible] buds. [illegible] the first having [illegible] on the second splitting [illegible] two [illegible] flower buds.

April 21, 1909

Culture 133. Took out three more [illegible] and cuttings to-day, one with a small callus, two without.

Culture 66. Pot [illegible] [illegible] first to [illegible]

Culture 137. ~~[illegible]~~ Cuttings, originally with [illegible] have a nice [illegible] callus at six bases. Two of these cuttings, most [illegible] [illegible] [illegible] the other none.

The three originally leather cuttings are all callused.

Culture 13[illegible]. Neither of the two cuttings [illegible] callused, and both are [illegible] [illegible]

April 21, 1908

Cultures 141–144. Plants and cuttings of *Vaccinium corymbosum*, ~~[illegible]~~ one of each number, from Col. Will A. S. Banks, Grand Junction, Mich.

Culture 141. Rooted plant of the variety "Blue Belle". Buds swelling. Soil attached to the roots black, chiefly organic matter. Potted in pure kalmia peat in a 4 inch pot and placed out doors. Col. Banks ~~[illegible]~~ writes of this plant as follows:

[quote]

Culture 142. Rooted plant of the variety "Secretary Wilson". Potted in a 6 inch pot in pure kalmia peat and placed out doors. Buds swelling. Col. Banks writes of this plant: [quote]

Culture 143. Cutting (dormant wood) of a variety called "Queen of the Garden". Placed in the cutting house with Mr. Gage's in a sand bed. Col. Banks says: Quote

over

[illegible] [illegible]. [illegible] [illegible] [illegible]
[illegible] [illegible] [illegible] 1-2, [illegible]
[illegible] [illegible]: [illegible]]

Juice of Fa [illegible]
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]

FROM

DELMONARDA FRUIT GARDENS

GRAND JUNCTION, MICH.

WILL H. S. BANKS, PROPRIETOR

HIGH BRED AND GRAFTED HUCKLEBERRIES
A SPECIALTY.

A LIMITED NUMBER OF ORDERS OF NOT OVER 12 PLANTS WILL BE RECEIVED AND FILLED THIS FALL.

A. E. Collins – 2 [illegible] [illegible]
[illegible] [illegible] put down – [illegible]
a [illegible] [illegible] [illegible]
[illegible] [illegible] carefully [illegible]
[illegible] digging, 1904 [illegible]
[illegible] [illegible] [illegible]
[illegible] in [illegible] [illegible]

FROM

DELMONARDA FRUIT GARDENS

GRAND JUNCTION, MICH.

WILL H. S. BANKS, PROPRIETOR

[illegible]

HIGH BRED AND GRAFTED HUCKLEBERRIES A SPECIALTY.

A LIMITED NUMBER OF ORDERS OF NOT OVER 12 PLANTS WILL BE RECEIVED AND FILLED THIS FALL.

Strong a [illegible] Plant — [illegible]
Great bloomer + in looks + greatly
only excelled by the [illegible]
Wilson. Plant not [illegible]
can safely [illegible] a [illegible]
green [illegible]

FROM

DELMONARDA FRUIT GARDENS

GRAND JUNCTION, MICH.

WILL H. S. BANKS, PROPRIETOR

Blue Bell

**HIGH BRED AND GRAFTED HUCKLEBERRIES
A SPECIALTY.**

A LIMITED NUMBER OF ORDERS OF NOT OVER 12 PLANTS WILL BE RECEIVED AND FILLED THIS FALL.

FROM

DELMONARDA FRUIT GARDENS

GRAND JUNCTION, MICH.

WILL H. S. BANKS, PROPRIETOR

**HIGH BRED AND GRAFTED HUCKLEBERRIES
A SPECIALTY.**

**A LIMITED NUMBER OF ORDERS OF NOT OVER 12 PLANTS
WILL BE RECEIVED AND FILLED THIS FALL.**

April 22 [illegible]

Cutting 130. Planted [illegible] the bed of the third bottle of [illegible] Fibre-grasses. A plant of Cutting [illegible] the upper grown but have a long [illegible] now [illegible] almost [illegible] waters and is still [illegible]

Cutting 120 5. Graft of Vac. [illegible] without success. No union has taken place, the scion having merely been kept alive by the wet moss around it.

On the shoot that was noted some time ago as having developed flowering buds in the upper 5 axils, at least five of the buds next below, which at first stopped ~~[illegible]~~ the leaf bud stage, are now developing into flowering buds

Cutting 120. The [illegible] of the two shoots is developing flowering buds in the axils of the upper 16 leaves, with additional flowering buds in axils of the [illegible]

April 23 1909

Cutting #5, a branch was layered this spring. [illegible] [illegible] [illegible]; [illegible] [illegible] [illegible] [illegible]. The [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible].

Fruiting plants in the Glasgow[illegible]. [illegible] on the [illegible] of Cutting #7 [illegible] [illegible] in the 12 mm [illegible] [illegible].

Picture 7 - [illegible] [illegible] of the [illegible] [illegible].

Cutting 89A. Twenty-five plants taken out of Cutting 89, leaving 24 plants. Growing less than 10 cm 18, more than [illegible] 20 cm. [illegible] [illegible] not growing 21, none; [illegible] [illegible] [illegible] [illegible].

Cutting 89. Twenty-one plants. Growing tips less than 10 cm 18, more than 10 cm 14, [illegible]; branches not growing [illegible]

31

Smithsonian blueberry bushes. Corollas beginning to fall. Standing water about the south bush.

April 24, 1909

Culture 41 A. This plant, which was pho-
tographed to-day, shows stem growth ~~at~~ only
two points, one a leaf bud which put out
a branch that withered, its [illegible] it had
made a fair sized leaf, the other a shoot
from one of the lower scales of a flowering. This
shoot now has an axis about 15 cm. long
and is still growing. The roots, ~~[illegible]~~
~~plant~~ as shown after knocking the
plant out of the pot, ~~[illegible]~~ have a
rather abundant new growth reach-
ing to the bottom as ~~[illegible]~~ well as
the sides of the pot. See note of to-day
on Culture 140.

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WASHINGTON, D. C.

April 2?, 191?

Peat treated with lime water by Dr. Posegate

5 gr. soil air dried required 190 cc. lime water before an alkaline reaction was obtained

1 liter lime water = 1.25 grams CaO

1cc. " " = .00125

$$\begin{array}{r} .00125 \\ 190 \\ \hline 11250 \\ 125 \\ \hline 5)\ .23750 \end{array} \quad 0.0475$$

Soil therefore 4½% lime when employed

Culture 77A A plant of Culture 77 (rose soil) was knocked out of the pot and the soil ~~[illegible]~~ washed carefully off the roots. The plant was then repotted in pure kalmia peat and given one watering with [illegible] water.

The main stem of the plant is 3 cm. high, the tip ~~[illegible]~~ stagnated ever since 77 was potted, and except the two minute leaves of the stagnated tip, the stem has lost all its leaves but three. There is also a [illegible] slender 5 leafed basal branch of 2.8 cm. height. The roots are very limited in extent ~~of~~ having made no appreciable growth since 77 was potted.

April 26, 1909

Cutting 47 Branches with apex over 20 cm. long growing one, terminated ~~x~~ three.

Cutting 47A Branches with apex over 20 cm long growing, four; terminated, five

Cutting 55. Branches with apex over 20 cm long growing, one, terminated, none

Cutting 55A. Branches with apex over 20 cm long, growing, four; terminated, none

Cutting 55 B. Branches with apex over 20 cm long; growing, one; terminated, one

Cutting 133. Took out three more blackened cuttings, two with a slight callus one not.

April 26 1905

Culture 120. The shoot that has its tip now seems to be flowering, the upper ten buds are flowering buds. The eleventh is a leaf bud, and the next two flowering buds.

Culture 105. All the plants but 5 are living and now showing new growth. In one the rosette is 23 mm. in diameter, the largest leaf having a length of 13 mm.

Culture 53. Three plants have made flowering buds all on the ultimate axillary bud of the first basal branch, one of them with a second flowering bud also. More plants appear to be starting flowering buds. The plants which purpled most after transplanting in 4" pots are not making flowering buds.

Culture 51. One plant has made a flowering bud, the ultimate axillary bud on the first basal branch

Culture 47A. One plant with flowering bud.

Culture 47. Four plants with flowering buds.

Culture 50. Three plants with flowering buds.

Culture 46. One plant with flowering buds.

Culture 45. Six plants with flowering buds.

Culture 44 Six plants with flowering buds

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF CHEMISTRY,
WASHINGTON, D. C.

April 27, 1909

"Soil" 74. Peat water from the barrel.

200 cc titrates 20 or $\frac{50}{100}$ (= ½) % normal

The barrel has been watered since titration 69 was made, but the peat water has been used so that the concentration is again large.

April 26, 1909

Soil 75 Sandy subsoil bearing poor growth of native Vaccinium. Lanham April 1909. East edge of Seofield's [illegible] Titrated .2

Soil 76. Top soil over soil 75, after [illegible] leaves are scraped off. Titrated 1.3

Soil 77. ~~78~~ Top soil in brush lot, west of Seofield apple orchard. Heavy growth of Vaccinium. Titrated 2.4

Soil 78. Sandy soil in wet area of Coffin's meadow field. Characteristic plants Juncus effusus and Sphagnum. .4

Soil 79. Sphagnum from surface of 78. .6

Soil 80. Bare liverwort and lichen area in Collins woods. Upper half inch of surface soil. .6

(over)

April [illegible], 1908.

Soil 61. Pure [illegible] peat, from a [illegible] 25 plants kept in my window sill (see note of this [illegible]) all winter. 1.5

May [illegible], 1908

Soil 62. Loam from [illegible], between [illegible] and [illegible]. [illegible] ground [illegible].

May 5, 1908

Soil 63. Soil from [illegible] 70, a [illegible] a hot worked over extensively by [illegible] [illegible].

Soil 64. Soil from a [illegible] of [illegible] not containing [illegible] [illegible].

May 10, 1908.

Soil 55. Woods soil from the rich woods [illegible] [illegible] opposite Plummers [illegible]. [illegible] [illegible], Galium [illegible], [illegible] [illegible] [illegible]. [illegible] [illegible] alkaline.
[illegible] carbonate 1%

May 13, 1908.

Soil [illegible]. Loam from the greenhouse. Watered since March 25 with [illegible] water (see [illegible] + 59) .4

Soil 59. Same from the greenhouse. Watered since March 25 with [illegible] water. (See 57 + 60)

Soil 58. [illegible] mold ([illegible]) from the greenhouse. Watered since March 25 with peat water, (See 61) .5

Soil 81. [illegible] [illegible], [illegible] [illegible] (see [illegible]) alkaline

April 23/1939

Culture 118. These ten plants are ~~[illegible]~~ in much worse condition than any of the 3-inch pot cuttings from 115 to 119 and from 122 to 129. The old leaves are purpled in all and there is no ~~[illegible]~~ growth of any sort except that [illegible] of the plants have ~~[illegible]~~ [illegible] branches, the longest being 2 cm.

Culture 137. One of the cuttings originally with leaves was found to be blackening and was removed. No roots had been formed, only a small callus.

[illegible] is dead and has been removed. No callus.

Culture 141. Buds, both flowering and leaf, fading.

Culture 142. Apparently dying.

Apr. 27, 1907.

[illegible], Oxen [illegible] [illegible] [illegible] to-day,

[illegible] [illegible] [illegible], one of them

about 7 mm long

[illegible]

[illegible]

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April 29, 1899.

Polytrichum commune occurs on all six pots of Culture 95, specimens from one of the pots having been identified by Prof. Britton, and on some of the other pots of Culture 94 & 98. It occurs also ~~[illegible]~~ on all 5 pots of 67A and on one pot of Culture 67, 68, 103, 34, & 35. It occurs abundantly all over that part of the field occupied by Culture 100, sparingly in 101 and not at all in 99. It occurs sparingly in some of the pots of Culture 105 ~~[illegible]~~ sparingly with green cabbage [illegible] It occurs on most of the pots of 111 & 112, not at all in 108

Culture 146. Two three inch pots of Bissell leaf mold inoculated with spores of Polytrichum commune from Culture 100.

Culture 147. Same as 146, but not inoculated.

Culture 148. A single pot of [illegible] [illegible] inoculated like Culture 146.

Culture 149. Same as 148, but not inoculated.

April 30, 1909.

Window sill plant of Cutting 25. Still in large drinking glass. Had an extensive root system last year, but no new root growth has started this year. Of the buds that started, all have lost their tips and most have withered. The plant looks very sickly. A test is to be made to ascertain the acidity of the soil. The soil is a pure kalmia peat, and has had no drainage.

May 1, 1909

Cuttings 133. Two cuttings with wilted new shoots 1 to 2 cm long removed from the box to-day. Both ~~blackened~~ brown and dead on the outside from the base to the surface of the sand, the pith still green. Cut ends blackened, slightly callused.

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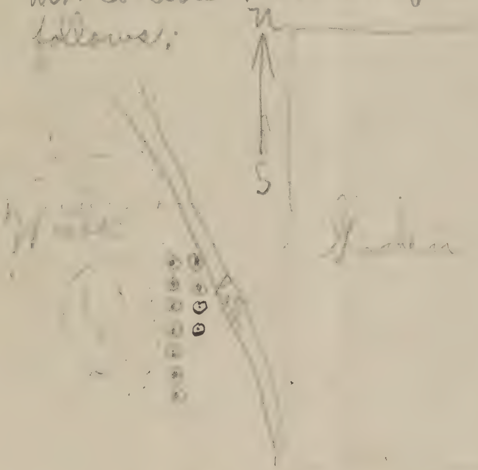
May 8, 1909.

Lanham

Set out seven plants of Culture 57 on Mr. Scofield's plat, finishing the west row of 12.

Set out nine plants of Culture 57 on Mr. Collins plat west of the garden, as follows:



Bulbs set with the top about two inches below the surface of the ground.

Plants indicated by ink marks set out May 16, 1909, Culture 53.

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May 3, 1908

Smithsonian blueberry bushes.

Flowers mostly gone. Those with corollas still remaining fresh are pendant, but the pedicels of young berries, from which the corollas and styles have dropped are curved upward.

The new twigs are now up to 6.5 cm. in length (apex measurement). No sugar globules were seen on the leaves.

Culture 130. Another bottle of lime water was set up on May 1. New bottle started away.

May 4 1904

Cuttings 78. The cheeka plant of this col-
lecting went to ~~the~~ winter ~~...~~ with foot only
to beg. The plant is now 2.5 cm high,
and has made no top growth which
~~...~~ ~~...~~
ever since it was placed in the glass.
It still bears its cotyledons and seven
leaves. One leaf has fallen. The leaves are
all ~~...~~ ~~...~~ puckled and have been
so ~~...~~ since shortly after potting. The
color is that of tarnished copper. The
upper axils, six at least, have leaf
buds in them the uppermost the largest
about .5 mm in length.

May 5/1909

Culture 137. Only the originally leafless cuttings taken out to-day (1 leaf) small callus but was dead and blackened. Those removed to-day.

Culture 136. Remaining cutting taken out. It was mostly dead, no callus

Culture 69. The Kalmia seedlings in that part of the sphagnum shaded in Culture 137 have lost all their purple color, in both young leaves and old, and are fresh green.

Culture 137. The root system of the plant is now extensive and vigorous, reaching the crystals in the bottom of the beaker and running all the way round the sides of the beaker. All the entire twig tips have withered but new shoots are starting from near the base. The longest twig upper is 7 cm.

Culture 139. Some of the larger plants have made a new growth of 6 to 8 mm., the youngest leaves being 1.5 cm long including the petiole.

May 6, 1939

Cutting 120. Both the larger shoots have sent out roots from the lower part of the shoot within the sphagnum. In two cases and probably in all the root emerges from the ~~vertical~~ stem at a point immediately above a rudimentary bud, ~~which~~ in turn stands immediately above a leaf scale of the stem. One of these roots was much branched, light brown at the base, and reached a total length of 5.5 cm.

Cutting 133. The new growth on two cuttings ~~has~~ having turned yellow and wilted, the cuttings were taken out. Neither has a callus. In both the bark is alive above the sand but below the surface ~~dead~~ brown and dead. The wood and pith however are still green in one, the pith only green in ~~a~~ a part of the other, and the whole stem including the pith brown in the remaining part.

A third cutting with green but drooping new leaves is slightly wilted but dead at the base, the bark dead from the base about half way to the surface of the sand.

Another taken out for microscopical examination.

May 5, 1939

Cultures 18, windowsill. The leaves on the tender shoots of this plant are withering today in the brilliant sunlight. The plant has made no new roots whatever since the winter. The new shoots are up to 5.6 cm long. It is the nearly full grown leaves that are succumbing, not the two or three near the growing tip.

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May 5, 1909

Culture 140. This and other plants on the window sill show conspicuously the exudate of sugary drops from glands along the midrib on the back of the leaf and on the margin of the leaf toward the base.

The exudate also occurs on Cultures 2a, 2b, 6, 15, 17, 22, 25, 29a, 29b, 113 (very sparingly, and perhaps formed sometime ago) + 41A. It is wanting on 18, 24, 30, 31, 145, 114. Culture 24 is feeble, 114 and 145 have roots and the leaves also are rather mature, and 18, 30, and 31 have only basal shoots with rapidly growing glandular pubescent herbage.

The exudate was tested by Mr. Jacobs of the Bureau of Chemistry, with Rochelle salts and sulphate of copper, and found to be not sucrose. About 50 of the globules were used for the test, all from Culture 140.

The plant (Culture 140) was knocked out of the pot, and after a careful examination ~~no~~ new root growth was found in the new peat in which the plant was potted this spring. A few new roots 2 to 4 mm. in length were found, however, within the surface of the old ball. The plant was put back again in the same pot and soil.

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May 6, 1904

Cutting on window sill. A few new roots 2 to 3 mm in length have appeared in this place.

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May 8 1929

Culture 66. Transferred this plant today from a drained drinking glass to a brick pot, in pure [illegible] peat.

Culture 132. [Same treatment as Culture 66]

May 7, 1937

Culture 57. Four plants potted in sedge peat 4 inch pots.

Culture 58
Culture 59
Culture 60
Culture 61
Culture 62
} [illegible] ?

Culture 88. Twelve plants potted in sedge peat. 4 inch pots.

[illegible]

Culture [illegible]

[illegible]

Culture [illegible]

May 10, '09

Culture 137. Began a new bottle of lime water on May 8.

Culture 42. Several of these plants, and of other numbers also, in the Sphagnum bed are making vigorous growth, the new shoots having made flowering terminals and then without waiting to ripen their wood and buds, the flower buds are beginning to open and the leaf buds in the axils below the flowering buds are making new shoots.

Culture 67. The new shoots on these plants have made flowering terminals and some of the flower buds are beginning to open.

Culture 146. Protonema is [illegible] on [illegible] pots. The seedling plants from which the [illegible] spores [illegible] but will be [illegible] growing.

Culture 143. No protonema has developed and no [illegible] plants growing. They [illegible] no protonema developed. The [illegible] plants

Culture 146. [illegible] plants [illegible] with the [illegible]

[illegible]

Culture 147. Nothing indicative of protonema.

Aug. 6, 1909

Culture 120. The shoot with the flowering terminal has a new bud in the axils of the lowest (shed) leaves (just above the sand) which are pushing. The longest is 11 cm. in length.

Culture 133. *Vaccinium parvifolium*, a plant received by Mr. Cleaver last fall from the Northwest Coast, and kept by him all winter in a pot. It has made new growths up to 31 cm., the latter from a [illegible] with stems of 6 mm. diameter.

Culture 133. Cuttings taken up to-day. Twelve had their cut ends blackened, nine without callus, three with small but callus. Wood and bark were dying down to within a few millimeters of the ~~cut~~ cut end. Eleven of these were reset and placed in the aquarium imbedded in sphagnum under the number 133A.

Fourteen ~~3~~ cuttings of 133 were [illegible] [illegible] places a root about 1 cm. in length. All were reset in the sand propagating bed.

May 10, 1909.

Culture 31. The two large shoots of the plant (apex 8.5 and 9.5 cm long) ~~with tips 8.5~~ are drooping to-day, though the weather is cloudy. Yesterday was sunny but the awning was down. The plant shows <u>no new roots</u>.

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11 — /53 — 12 plants sent
over to Miss Huddleson to day to
be [illegible]

Glendale, Md.

May 11, 189[illegible]

[illegible] Began [illegible] with [illegible] May 4. [illegible] formed [illegible] the [illegible]

[illegible]

May 12, 1909.

Cultures 108 to 111A were gone over to-day and all wood and leaves containing the cockle-leaf mite was cut off.

May [illegible]

[illegible] 117. [illegible] have [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]

[illegible] 118. The buds [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] longest [illegible] [illegible] ~~[illegible]~~ length.

Cutting 132. This cutting was [illegible] of a few days ago and [illegible] have a [illegible] [illegible]. One of the new shoots is more than [illegible] long.

Cuttings 119. Longest shoot 5.0 cm.

Cuttings 133. Seven of the cuttings have [illegible] new growth of a healthy green color. The other seven are [illegible] or brown.

May 14 '09.

Culture 55B. The plants of this culture are the ~~most~~ tallest ~~vigorous~~ of any of ~~the~~ the 1908 seedlings. One of them has a shoot with an axis 14 inches long to-day, eight months from the sowing of the seed.

May 15, 1907

Culture 130. Another bottle of lime water finished this morning.

May 18, 19[illegible]

Culture 67. On two plants new shoots have formed which appeared [illegible] bearing flower bunches about an [illegible] [illegible] long.

Culture 92. The [illegible] plant with four new flowering bunches [illegible] flower on May 15. A second plant has [illegible]

Cutting 150. Eleven pieces of roots about 2 inches long and 1/3 inch in diameter made today from roots were [illegible] to-day from Rabbit Hat, from the Brooks bush. The cuttings were placed in a box with a layer of fibrous kalmia peat at the bottom, then about 2 inches of clean sand, then the cuttings, then about 1/4 inch of sand. Set in the sun in the propagating house, without cover, and kept watered

Brooks bush May 19, 1909.

To-day had Mr. Doyle photograph sixteen berries out of the bottle of berries from the Brooks bush kept in formalin since last August.

Of the berries photographed eight were 13 to 14 mm. berries, eight 12 to 13.

The bottle contains thirty berries, as follows:

11 to 12 mm.	13 berries
12 to 13 mm.	9 berries
13 to 14 mm.	8 berries

The two or three largest berries almost caught in the 14 mm. hole.

Culture 67. Plant photographed to-day, with flower on a new shoot grown from a bud on the cutting.

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May 20, 1919.

Soil 90 Cow manure that has been lying out all winter at the Bot greenhouses in a thick pile. Now full of striped worms. Used in potting mixture for Cultures 155 and 153. 1.2

Soil 91. Coconut fiber under cover two years 3.4

Soil 92. Coconut fiber two years on greenhouse benches. .4

Soil 93. Cow manure, fresh, from Lanham. 4. (after worms?)

May 20, 1919

Soil 94. Culture 70, containing worms .5

Soil 95. Culture 70, containing worms .5

Soil 96. Culture 71, no worms .8

Soil 97. Culture 71, no worms .8

May 22

Soil 98. Peat mixture (peat 8, sand 1, loam 1) used in Cultures 151 + 152. 1.5

May 20, 1909.

Culture 151 Three 6 inch pots filled with peat, sand, loam, placed in the Agronomy Lab. To be kept moist like a potted plant and the behavior of the soil noted in comparison with Culture 152.

Culture 152. Same as Culture 151 except that five ~~[illegible]~~ earthworms were placed in each pot.

Cultures 70 and 71. In some of the pots the earthworms have worked and the soil instead of being granular has amorphous plastic texture approaching that of clay. This soil has evidently passed through the alimentary canal of the earthworms

May 21, 1909.

Culture 140. Most of the new branches have withered their tips and all apparently are preparing to do so. The uppermost branch on the main stalk is 11.2 cm. long, and with a withered tip. The longest branch ~~on~~ this stalk, also with withered tip, is 12.5 cm. long.

The small old twigs at the base of the plant are trimmed off to-day.

Knocked out of the pot the ~~[illegible]~~ plant shows active root growth in a cavity next to the old ball. The new roots have not yet, however, reached the surface of the new ball.

May 27, 1909.

Culture 140.

All the early branches have ~~[illegible]~~ withered their tips. The longest is 13.5 cm. One branch from near the base 15 cm long is still growing.

June 14, 1909.

Culture 140. The ultimate buds on some of the upper twigs of the season, which withered their tips some time ago, have started to make ~~a~~ new growth

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May 21, 1909.

~~Cuttings 67, 67A, 55, 103, 104~~

Cutting 35. Three plants. Repotted in 6-inch pots in peat sand loam peat.

Cutting 67. Four plants. [Same treatment as 35]

Cutting 67A. Five plants. [Same]

Cutting 55. Three plants. [Same]

Cutting 103. Seven plants [Same]

Cutting 104. Three plants. [Same]

May 22, 1909.

Cutting 43. plants. Repotted May 19 & 20 in 6-inch pots and placed out doors plunged in sand in a cold frame with a half shade of slats. Soil of peat 5, sand 4, loam 1.

Cutting 47 plants. [Same treatment as 43, but date May 20]

~~Cutting 47A [...]~~

Cutting 47A. plants [Same treatment as 47]

Cutting 55 plants [Same treatment as 47, but date May 21]

Cutting 55A plants. Repotted to-day in six inch pots in peat 7, sand 1, sand, loam

(378) and plunged ~~[illegible]~~ in sand in a cold frame, with a half shade slat covering.

Culture 153. The six tallest plants of Culture 55A, repotted in six inch pots in peat 7, manure 1, sand 1, loam 1, with no leaf mold between the old ball and the margin of the new pot. Plunged in sand in a cold frame with half shade slat covering. The axis of the lowest shoot on each plant measured 10.5, 11, 11, 11, 14, and 14.5 inches.

Culture 67A. When these plants was repotted yesterday it was found that the root growth was not vigorous in the leaf mold part of the pot, while in all the other cuttings without leaf mold, (Cultures 67, 55, 60, 118) the root development ~~[illegible]~~ was uniform and larger.

The manure used in this culture and Culture 55A was cow manure, from the pile that has been lying out all winter at the greenhouse. As soil it titrated acid 1.2. In order to kill the earthworm eggs with which it abounded it was spread out in an oven for six hours at a temperature of 65° C., the soil itself maintaining a temperature of 50°. This is believed to have killed the eggs.

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May 22, 1907.

Window sill cultures.

Conspicuous new rooting in several of the glass pots, that have heretofore shown no roots, is observed to-day. These pots, rooting and not rooting are noted as follows:

Culture 6. Many new roots, 4 mm. or less in length, in all parts of the pots. First spring growth of the tops stopped some time ago. Secondary growth now starting.

Culture 15. Many new roots a few millimeters in length have developed especially toward the bottom of the pot and on the side away from the sun. Two spring branches are continuing their growth.

Culture 17. No new roots can be seen through the glass. After knocking out the ball, washing the glass and replacing the ball a very few new roots are discernible near the bottom crock. New growth has stopped and has not been resumed.

Culture 22. Many new roots are to be seen, in all parts of the pot, up to 4 cm. in length. Spring growth had stopped but is now resumed.

Culture 24. No new roots in either of the pots, even in the heavy mulch of one containing a mass of old roots.

Culture 25. No new roots though some of the spring growth still continuing slowly

Culture 26a. Several very short new ([illegible] roots) forming in

(over) the sphagnum overlying the sand. New growth starting.

Cutting 29b. Many new roots starting, nearly all in the sphagnum above the sand. First growth of tops stopped, second not yet started.

Cutting 31. No new roots on the outside. Shoots still growing from the cut stumps of the old wood, the longest shoot 13.0 cm long, and in this cloudy weather not wilting.

Cutting 30. No new roots on the outside. Shoots still growing from the cut stump, the longest 120 mm.

May 27, 1909.

Culture 132. Berry no purple to-day.

May 28, 1909.

Berry ripe to-day.

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May 28 1907.

Cutting 100. The remaining bud on the better of the two ~~[illegible]~~ grafts is elongating [illegible] to push. The alburnum on the [illegible] graft is swelling.
The new shoot from the base of the graft older shoot is now 9 cm long.

May 2[illegible] 1908

On May 25 & 26 [illegible] went over the 3-inch pots of cultures ~~[illegible]~~
and removed ~~[illegible]~~ [illegible] of [illegible].
In some cases the [illegible] the [illegible]
[illegible] in [illegible] the whole plant.
The numbers [illegible] in the various cultures
are as follows:

Culture	114	24.
	115	10
	116	7
	117	10
	118	10
	119	6
	122	19
	123	21
	124	24
	125	41
	126	23
	127	13
	128	23
	129	23

Culture 117. These plants are the most [illegible] of any in the 114–119, 122–129 cultures. The [illegible] [illegible] is 7 cm. in height.

Culture 127. These plants are now making the most vigorous of any in the 3-inch pots of cultures 114–119, 122–129. ~~[illegible]~~ They have made [illegible] up to 20 cm. in length and [illegible] [illegible]. [illegible] growth is especially characterized by the [illegible] [illegible] leaves. Some of the plants [illegible]

[illegible]

May 2[illegible], 1901.

Lettere 133. Seven cuttings that cast all their leaves and for the most part blackened their stems were removed today having even with almost new growth beginning the leaves still green.

May 21, '08.

Cistern 130. Began a new boring [illegible]
[illegible] about May 23, half [illegible] of [illegible]

G. & G.

May 28 '37

Now in cold frame the following.

Cultures 43	67	plants 6 in pots
47	26	" " "
47A	26	" " "
55	30	" " "
55A	20	" " "
55B	20	" " "
153	6	" " "
35	3	plants 5 inch pots
67	4	" " " "
67A	5	" " " "
68	3	" " " "
103	7	" " " "
104	3	" " " "
88	12	plants 4 inch pots
65	22	" " " "
65A	20	" " " "
89	26	" " " "
89A	25	" " " "
64	31	" " " "
34	2	plants 5 inch pots
90	52	plants 4 inch pots
112	10	plants 4 inch pots (potted May 2?)
112A	10	" " " " " "

May 27, 1909.

Windowsill cultures. Transferred the following from undrained to drained 3-inches glasses to-day: 6, 15, 17, 22, 29(?), 29a, 29b, 30; and the following from 3-inch pots to drained 3-inch glasses: 2a, 2b. ~~culture~~

Cultures 2a & 2b were given a deep covering of half alive sphagnum.

Culture 29a had the old soil and all the lower roots cut off, then the plant covered deeply with half live sphagnum.

Culture 29b had the old soil washed off and the whole covered deeply with half live sphagnum.

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May 29, 1909

Culture 112 B Ten plants potted to-day, still in greenhouse.

May 29 '1?

Cultures 47 + 47A measured to-day, as follows:

47	[illegible] mm	2125	4289
	250	[illegible]	180
	174	217	228
	205	163	168
	237	207	205
	193	225	190
	190	192	5260
	187	238	
	210	175	
	260	162	
	2125	170	
		155	
		4289	

$$26)\,5260\,(\,202$$
$$\frac{52}{60}$$

Average height 202 mm

47A	210 mm	2442	4699
	213	225	243
	231	185	270
	275	285	252
	242	195	260
	[illegible]	215	285
	[illegible]	212	247
	230	270	6256
	242	230	
	295	200	
	2442	240	
		4699	

$$26)\,6256\,(\,241$$
$$\frac{52}{105}$$
$$\frac{104}{16}$$

Average height 241 mm

May 28, 1909.

Culture 109. Two plants rotated from 4 in to 5 inch pots. Fresh peat, humus. Plunged.

May 29, 1909.

Kalmia peat

Twenty barrels of fresh kalmia peat received yesterday and to-day.

Cultures 108 + 109 etc. These are decidedly better than 110, 110A, 111 and 111A. Culture 108 has made a little better growth than 109. Cultures 110 and 110A are perhaps no larger than 111 and 111A but they are of much better color, the last two having their leaves decidedly purpled and yellowish green. The length of the tallest branches (measuring only those not turned or on account of the mite) is as follows:

108
190 mm.
183
1[illegible]
2[illegible]
2[illegible]
275
2[illegible]
170
180
182
140
145
172
92

14) 2599 (186
14
11[illegible]
[illegible]
77

Average height 186 mm.

109
190 2686
205 184
127 205
225 165
146 122
175 164
155 152
137 124
135 82
160 185
134 126
105 155
1[illegible] 127
1[illegible] 135
14[illegible] 178
1[illegible] 152
[illegible] 150
[illegible] 3090
[illegible] 149

2686

34) 3090 (149
34
169
136
330
306
24

Average height 150 mm

(over)

Over

110
75
153
136
120
[illegible]
135
115
130
120
108
120
120
110
90
[illegible]
1734

15)1734(116
15
23
15
84

Average 117 mm

110A
105 1764
79 132
110 85
135 125
123 103
[illegible] 85
95 95
78 2389
[illegible]
[illegible]
[illegible]
85
113
[illegible]
65
[illegible]
70
1764

23)2389(104
~~207~~
~~31~~
~~207~~
89

Average ~~104~~ mm.

111
95 1623
[illegible] [illegible]
[illegible] 80
132 85
135 76
130 132
[illegible] [illegible]
[illegible] 2241
97
95
120
[illegible]
62
120
95
1623

21)2241(107
21
141

Average 107 mm.

111A
100 1401
[illegible] 110
105 95
97 92
70 [illegible]
123 [illegible]
100 80
[illegible] [illegible]
[illegible] 2073
[illegible]
[illegible]
[illegible]
[illegible]
1401

Average 104 mm.

20)2073(104
20
73

May 29, 1909

Cultures 56 + 56 A. Culture 56 A is decidedly larger and with more growing tips, and with more large leaves than 56. The average height of the plants is as follows

56

115 mm	2427	4865
180	210	202
185	221	160
252	215	162
205	185	212
188	165	210
112	240	196
140	230	253
190	170	250
203	159	230
210	220	6698
185	175	
160	142	
120	155	
2427	4865	

36) 6698 (186
36
309
288
218
216

Average 186 mm.

56 A

152 mm	3975	7455
232	163	234
210	183	185
183	186	165
180	238	205
158	258	310
223	217	316
230	221	196
220	190	9088
211	188	
142	177	
178	165	
352	142	
318	157	
175	83	
208	216	
169	322	
205	187	
	165	
3975	7455	

Average 211 mm

43) 9088 (211
86
48
43
58
43

B P I

May 30, 1909.

Culture 55 + 55 A. The relative size of plants is as follows.

55

137 mm.	1550	3332	5088
175	217	187	160
175	217	225	235
107	180	205	212
178	178	235	5695
185	198	232	
110	160	292	
255	217	202	
198	190	178	
1550	225	5088	
	3332		

$$29)\,5695\,(196$$
29
279
261
185
174

Average height 196 mm.

55A

187	1709	2813
[illegible]	245	112
[illegible]	~~[illegible]~~	155
[illegible]	~~[illegible]~~	204
156	185	242
[illegible]	[illegible]	142
[illegible]	~~[illegible]~~	3708
150	185	
[illegible]	174	
1709	205	
	2813	

Also of Culture 153 (formerly 55 [illegible])

$$20)\,3708\,(185$$
20
170
160
108
100

$$26)\,5543\,(213$$
52
34
26
83
78

360 mm
385
270
275
275
270
6) 1835
306

Average height 213 mm.

55B

270 mm	2497
310	165
242	205
153	225
275	180
233	175
190	170
128	222
236	265
217	215
243	4319
2497	

$$20)\,4319\,(216$$
40
31
20
119
120

Average height 216 mm.

Greenfield, N.H.
June 7, 1907.

Blueberry meadow

Ten rows of holes ~~[illegible]~~ 8 x 8 feet prepared for blueberries by chopping up the ground to a diameter of 18 inches with a grubbing hoe.

Tenth and ninth rows (from east) 21 plants each planted with Culture 99. Plants [illegible] [illegible] [illegible] [illegible].

Eighth row, 22 plants, planted with Culture 131, starting with [illegible] and [illegible] [illegible].

Seventh and sixth rows 24 plants each set with Culture 131, but the plants trimmed, each shoot being cut back one third to one half its length. Shaded with [illegible], [illegible] [illegible].

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Greenfield, N.H., June 7/1927.

Orchard blueberries

Seventh row (from east)

Tenth plant (from east) in flower (1 flower)

Sixth row (from north)

First plant (from east) in flower (7 flowers here [illegible])

Fourth row (from north)

First plant (from east) in flower (1 flower).

In the orchard plantation very few seem to be dead, a considerable number feeble. Many are growing well, some having already made twig growth of 5 cm.

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BPI

Soil 99 Loam, same as Soil 86, but given ~~water~~ only water, no peat water, since May 13. June 4, 1909

Soil 100. Sand, same as Soil 87, but given only water, no peat water since May 13. .1

Neutral

Soil 101. Leaf mold same as Soil 88, but given only water, no peat water, since May 13

Alkaline

Soil 102. Peat mixture from a pot of Culture 70 .7

Soil 103. Earthworm experiment from the surface of Soil 102. 1.0

Soil 104. Peat mixture from a pot of Culture 71. .9

Soil 105. Earthworm experiment from the surface of Soil 104. 1.1

Bryngfield ... June ...

Blooming of meadow plantings of June 1905

Row ~~8~~

Plant 1 from ...
Feeble (41)
2 Fair
3 "
4 "
5 Fair
6 "
7 "
8 "
9 Feeble
10 "
11 "
12 "
13 Good
14 Feeble (41)
15 Fair

Row 10
Plant 1 (from south)
Feeble (41)
2 " (41)
3 " (41)
4 Fair
5 "
6 Feeble (41)
7 Fair
8 "
9 "
10 Fair
11 Feeble 72
12 Fair

Row 1
Plant 1 from south
Fair
2 Fair
3 ~~Feeble~~ Fair
4 Flowering from one side
5 Fair
6 Good
7 Feeble (41)
8 Fair
9 Fair
10 Feeble (41)
11 Fair
12
13 Feeble (41)
14 Fair
~~[illegible]~~
15 ~~Feeble~~ Fair
14 "
15 Feeble (72)
Feeble (72)
16 Fair (... ...)
17 "
18 "
19 Feeble (72 A)
20 Fair
21 "
22 Good
23 Feeble (72 A)
24 Fair

$\frac{176}{143}$
32

176

25 Fair
26 Flowered from 2 ...

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[illegible]field, N.H. June [illegible]

Orchard blueberries

First (south) row, east end.
First Good
2 "
3 Feeble
4 Fair

Second row
First Good
2 "
3 "
4 "

Third row
1 Fair
2 Good
3 Fair

Fourth row
1 Good
2 "
3 Fair

Fifth
1 Fair
2 Good
3 "
4 Fair

Sixth
1 Good
2 "
3 Flowers from 1 bud
4 Fair
5 Good

Seventh
1 Good
2 "
3 Fair
4 Good
5 Flowers (?)
6 Fair

Eighth row
First Fair
2 Good
3 Fair
4 Good
5 "
6 Fair

Ninth
1 Good
2 "
3 "
4 "
5 "
6 Flowering from 1 bud

Tenth
1 Good
2 "
3 Feeble
4 Feeble
5 Good
6 Fair

Eleventh
1 Fair
2 Feeble
3 Good
4 Fair
5 "
6 "

Twelfth
1 Feeble
2 Fair
3 Fair
4 Good
5 Feeble
6 Good
7 "

Thirteenth row
1 Fair
2 "
3 "
4 "
5 "
6 Good
7 Fair

Fourteenth
1 Fair
2 "
3 "
4 "
5 Feeble
6 "
7 Fair

Fifteenth
1 Fair
2 "
3 "
4 "
5 "
6 Good
7 "

Sixteenth
1 Feeble
2 Good
3 Fair
4 "
5 "
6 "
7 "

Seventeenth
1 Fair
2 "
3 "
4 Feeble
5 Fair
6 Good
7

Eighteenth row
1 Flowers 1 bud
2 Fair
3 Fair
4 Fair
5 Fair
6 Fair
7 Fair
8 Fair

Nineteenth row
1 Fair
2 Feeble
3 Fair
4 "
5 Feeble
6 Fair
7 "
8 "

Twentieth row
1 Feeble
2 Feeble
3 Dead
4 Dead
5 Fair
6 Fair
7 Feeble
8 Dead

Twenty first row
1 Dead
2 Feeble
3 Fair
4 Dead
5 Fair
6 Feeble
7 Fair
8 Dead

(Turn)

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Twenty second row
1 Fair
2 Feeble
3 Fair
4 Feeble
5 Fair
6 Dead
7 Fair
8 Feeble

Twenty third row
1 Feeble
2 Fair
3 "
4 Feeble
5 "
6 "
7 Dead
8 Feeble

Total plants 173
Dead 7
Flowered 7

Greenfield June 4. 1909.

Blueberry meadow continued from yesterday

Fifth row set with plants of Culture 72 A, shaded with Acer saccharinum. Twenty-four plants in row not trimmed.

Fourth row, twenty-five plants, set with Culture 72, each shoot trimmed back about a third, shaded with Acer saccharinum.

Third row, 25 plants, south 19 holes set with Culture 46, north 6 with Culture 45, not trimmed, shaded with Acer saccharinum.

Second row, 24 plants, set with cult. 44, shaded with Acer saccharinum, not trimmed.

First row, six plants, set with Cult. 44, shaded with Acer saccharinum, not trimmed.

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Greenfield N.H. June 4, 1909

Brooks bush

Self-pollinated ~~the~~ three branches on the Brooks bush to-day. First removed all the open flowers that had been pollinated. Then pollinated the few flowers that had just ~~been~~ opened, but the stigmas of which had as yet received no pollen. Removed one calyx lobe ~~apex~~ from each of the pollinated flowers. Then tied up each branch in thin cloth(   ) so as to keep out insects. Will the buds pollinate themselves?

The well developed flowers on this bush are 10 x 7 mm. & the calyx lobes are very short and rounded, about twice as broad as long.

Flowers taken to pollinate bush at the farm.

Stanley bush.

Pollinated 1 flower with Brooks bush pollen.

" another "

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[illegible] [illegible] June [illegible], [illegible]

[illegible] [illegible] [illegible] $\overline{c}$ 1900.

[illegible] [illegible] [illegible] [illegible] [illegible].

Row 1 (from west)

Plant 1 (from south) ~~[illegible]~~

[illegible] [illegible]

2

3 Growing [illegible]

4 Flowering [illegible]

5 [illegible]

6 ~~[illegible]~~ (50) [illegible]

7 Growing finely [illegible] (50)

8 [illegible] [illegible]

9 [illegible] [illegible] small.

10 [illegible] [illegible]

11 Flowering [illegible] 7 [illegible], [illegible] [illegible] matured.

12 Growing [illegible]

13 Flowering [illegible] one [illegible]

14 Growing good.

15

16 [illegible] [illegible]

17 [illegible] [illegible]

18 [illegible] [illegible]

19 [illegible] [illegible] (50)

20

Row [illegible]

Plant 1 (from south) [illegible]

2 Good

3 "

4 Flowers on two [illegible] [illegible] [illegible]

Plant 5 Good

6 Dead (50)

7 Fair

9 Flowering [illegible]

Plant [illegible] [illegible] 17 [illegible]

12 [illegible] 18 [illegible]

13 [illegible] 19 [illegible]

14 Dead (50)

15 Fair

16 Fair

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Row 3
Plant 1 (from south) Fair
2 Good
3 Fair
4 Good
5 Fair
6 Good
7 Good
8 Good
9 "
10 Fair
11 Good
12 Fair
13 Fair
14 Flowering buds(?) nearly ready to [illegible]
15 Fair
16 "
17 Good
18 Feeble (5-0)
19 Flowering [illegible] [illegible]

Row 4
Plant 1 (from south) Good
2 Fair
3 Flowering bud [illegible]
4 Flowers in bud nearly ready to [illegible]
5 Good
6 Fair
7 Fair
8 Fair
9 "
10 Dead (5-0)
11 Fair
12 Feeble
13 " (5-0)
14 Fair
15 "
16 Feeble
17 " (5-0)
18 " (5-0)

Row 5
Plant 1 (from [illegible]) [illegible]
2 Fair
3 Feeble
4 Fair
5 Feeble
6 Feeble
7 Fair
8 Fair
9 Feeble (5-0)
10 Feeble (5-0)
11 " (5-0)
12 Fair
13 "
14 Feeble (5-0)
15 Good
16 Dead (5-0)
17 Fair

Row 6
Plant 1 (from south) Fair
2 "
3 "
4 "
5 Feeble (5-0)
6 " (5-0)
7 " (5-0)
8 " (5-0)
9 Fair
10 Feeble (4-0)
11 ~~Feeble~~
12 "
13 [illegible]
14 Fair
15 Dead (5-0)
16 Feeble

Row 7
Plant 1 (from south) Fair
2 Feeble (4-1)
3 Good
4 Fair
5 "
6 Feeble (4-1)
7 Fair
8 Fair
9 Fair
10 Feeble (4-0)
11 Fair
12 Good
13 Feeble (4-1)
14 Fair
15 "
16 "

[illegible]

Blueberries in [illegible] field)

Beginning at west end.

1 Feeble
2 Fair
3 Feeble
4 "
5 Fair
6 "
7 Feeble
8 "
9 Feeble
10 Fair
11 Fair
12 "
13 Dead
14 Feeble
15 Fair
16 "
17 "
18 "
19 "

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June 8, 1899

Visited 17 and 18. Gall [illegible] [illegible] the [illegible]
([illegible] were fully grown and [illegible])
Only one worm (a very small one, smaller than
one placed in the [illegible]) found in any of the
[illegible]

June 9 1909

Cuttings 1220. The remaining bud at the end of the first node of the last graft has developed only slightly in length and is not strongly feathering. A bud lower down on the second graft has grown and made an axis 4.3 cm long. The right bud at the end of the third shoot on the other graft has made an axis 1.5 cm long and withered the tip.

The new shoot that started from the base of the other shoot on this plant has withered the first 12 cm.

June 9, 1919

Culture 99. Plants measured to-day as follows:

173 mm.	105	153	$16\overline{)2813}(176$
155	165	149	16
168	150	245	121
187	153	164	112
172	220	215	9
		185	

Average 176 mm.

Culture 100. Height of plants to-day as follows:

128 mm.	82	106	$15\overline{)1550}(103$
117	97	113	15
110	97	115	50
100	115		
141	88		
95	110		

Average 103 mm.

Culture 101 heights of plants to-day as follows:

175 mm.	150	132	135	
200	161	195	127	$20\overline{)3069}(153$
153	127	98		20
148	155	146		106
160	158	142		100
114	162	120		69
				60

Average 153 mm.

In addition to the difference in height, the leaves of 99 are distinctly larger, and the stems notably thicker than those of 101.

Culture 103. The length of the longest ear is 395 mm (15½ in.) including the uppermost leaf 450 mm (17¾ in.)

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June 10, 1909.

Precipitation of lime.

In connection with the possible precipitation of lime from the lime water with which Culture 130 has been watered, in the upper layers of the earth in the pot, which is suggested by the appearance of the soil and the roots in one of the pots, Mr. Breazeale to-day took an acid peat soil (Soil 14), moistened it, then stirred into it dilute lime water ~~into~~ reddened with phenolphthalein, and immediately poured the mixture into a filter. Ten seconds elapsed from the time when the lime water was mixed with the soil to the time when the liquid began to come through the filter. It came through without a trace of red color, showing that the lime had been precipitated out.

Subsequently he poured ~~into~~ the moist soil in the filter an additional amount of the reddened lime water, and it came through clear, in four seconds.

The precipitation of the lime is practically instantaneous.

June 10, 1931

Culture 130. A new [illegible] of [illegible] which began about June 3, is nearly finished.

Culture 70. A [illegible] of the colony in the [illegible] has [illegible] masses of [illegible] up to 2 mm. in length and 9 mm. in breadth.

~~June 14 1908~~.

June 11 1908.

Culture 133. Took up the seven remaining cuttings today. Five were rooted. These five were potted; the other two put back in the propagating bed.

The 5 rooted plants were put in thumb pots in old peat 8, glass sand 1, rotted cow manure 1, and placed under a shaded, ventilated bell jar.

Culture 130 June 12, 1909.
A plant of this culture examined today.
Top layer about 3 mm. thick alkaline, without boiling.

Next layer, about 15 mm. thick, no roots at margin, alkaline after boiling.

Third layer, about 4 mm. down, containing brown and dead roots, dying next to the rootless area. Slightly alkaline on June 14.

Fourth layer, about 5 mm. down, the surface bearing a dense layer of live roots, the interior with few but live roots.
Distinctly acid on June 14.

Fifth sample, at depth of 4 to 7 mm., along the label, no roots, alkaline after boiling.

Sixth sample, from the bottom immediately above the crocks. Distinctly acid on June 14.

The surface for a depth of 1 or 2 millimeters is gray and lime-incrusted.

The upper part of the soil, for a depth varying at different points of the circumference from 1.5 to 3.5 cm contains no roots. Along the label all the way to the bottom of the pot are no roots. At all other parts of the surface of the ball, including the bottom among the crocks there is a dense covering of live roots.

The plant ~~had~~ is 230 mm. high (4th stem) and has two new shoots ~~150~~ 15 + 25 long.

Samples 3, 4 and 6 did not show an alkaline (over)

reaction on boiling after treatment with water and phenolphthalein. They will be allowed to stand over until June 17 for a more careful test.

Shall begin watering Culture 4/30 with a new bottle of lime water to-day.

Samples of roots from this plant were taken to-day and preserved in   solution.

Near the lime-saturated zone, the rootlets appear more inclined to show the stag-horn form.

June 14, '09.

June 9, '19

Smithsonian bushes. Some of the berries left. Many of the growing tips and younger leaves wilted and brown, undoubtedly because of the hard sunlight after the long period of cloudy and cool weather. Leaves browning and drying at tips first. Berries very few — compared with flowers.

North bush with berries black and shining, no bloom; south bush with berries thickly with a bluish bloom.

June 16, 1919.

Blueberries in market. Blueberries (huckleberries) from South Carolina have been in the wholesale market for about two weeks, and have sold by the ~~box~~ crate at 8 to 12 ¢ per quart box, according to condition. They were evidently picked with a rake. Individual berries were found, as large as the New Hampshire berries.

June 17, 1909

Kalmia latifolia

1 ~~a~~ Peat 8, sand 1

2 ~~b~~ " " , crocks

3 ~~c~~ Peat 8, sand 1, manure 1, crocks

4 ~~d~~ " " " "

5 ~~e~~ " " " "

Plants from Bobbink & Atkins.

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Springfield, N. H., June 27, '10.

First ripe blueberries (Vaccinium pennsylvani[illegible]
seen today — in Brooks pasture.

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Greenfield. June 29, 1909

Mr. Frank Russell's Pecs. Budded as follows:
Celestia. First tree northeast of corner of barn, about 60 yards. Five buds.
Jefferson. Tree about 60 feet a little west of north from the Celestia tree. Five buds.

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[illegible], June 3[illegible], [illegible]

Blueberry meadow.

First row from east

Plant 6 from south, new planting Culture 45, about in bloom.

" 10 has made new shoots up to 10 cm long, and still growing.

[illegible] has 2 green berries.

Second row

Plant 4 has 5 green berries

Third row

Fourth row

Fifth row

Plant 5 new planting, Culture 50, has made new twigs since planting, up to 4.5 cm.

Plant 6, same 5.3 cm. [illegible]

Plant 7, same, 6 cm. new twig

Sixth row

Plant 2, new planting, Culture 50, new growth 9.5 cm

Plant 8 numerous twigs up to 9 cm

Plant 9, new planting, Culture 50, 3 vigorous shoots from [illegible] cut back [illegible], the longest now 1[illegible] cm long and growing rapidly.

Seventh row

Plant 3 has 4 fruits set.

Plant 4, 2 fruits set

Eighth row

Plant 2, numerous twigs from near summit of old stem, up to 9 cm long.

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Greenfield, June 30, 1909
(Con. 2)

Eighth row (con.)

Plant 5, numerous twigs up to 13 cm. long.
Plant 6, " " " " 14 cm. long from
dead-back stems.
Plant 7, shoot-twigs from died-back stems, up
to 17 cm. long.
Plant 8, same as plant 7.
Plant 1, same as 7 and 2.
Plant 14, with 14 green berries
Plant 17, same as 1, 5, 7-2, but twigs up to 10 cm.
Plant 18, new planting, Cuttings 50, flower ready to
open in a few days
Plant 19, with 2 green berries.
Plants of this row averaging better than any of
the other rows.

Ninth row

Plant 4, with 1 green berry.
Plant 9, in flower, old plant Lot 1, 5 isolated
flowers. Dead twigs show that on this plant, as
doubtless on many others, flowering buds that
formed on these plants were later killed but
by the death of the twigs, either through
last autumn's growth or by winter killing.

Tenth row

Plant 5, with 15 green berries, on three twigs.
Plant 6, fruitless
Plant 10, with 9 green berries
Plant 14, with two green berries withering on account
of injury to the twig.

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Greenfield, June 30, [illegible]
(Con. 3)

Tenth row (con.)

It appears that out of the planting of 1908 in this meadow 10 plants set fruit this year, this being a percent of . The plant with white flowers, ninth row, plant 9, may also set fruit.

The growth of vegetation in the ploughed land, rows 2 to 8 and plants 1 to 13 of row 9, is much greater than in the area not plowed, the removal of ~~encroaching~~ ~~[illegible]~~ weeds from the mulched circle of ~~[illegible]~~ 1½ to 2 feet diameter about each plant requiring the expenditure of probably 5 times more time than on the non ploughed area. The weeds encroaching are particularly Potentilla canadensis, Fragaria virginiana, Rubus , Rubus , Agrostis and Poa pratensis. It is not clear that the plants in the ploughed area are better than those in the unploughed area.

Eleventh row (beginning of new planting) (Fall cuttings of [illegible])

Only a few of the 25 plants in this row have made any new growth. They have the same appearance as the pot bound or acid choked plants of the greenhouse, with many furled leaves and reddish yellowish foliage. The plants

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Greenfield, June 20, 1907
(con. 3)

Eleventh row (con.)
of Cultures 5-0 used in replacing the dead or feeble plants of rows 1 to 10 show no such symptoms, nearly all of them showing a healthy color and good growth. The plants in row 11 eleven were not mulched with leaves, and at first sight the difference may have been due to dryness, but some of the plants in the row are in low ground, still moist to the surface and these plants are in still worse condition, having lost many of their lower leaves. Whether well shaded or not, also, the plants in new-chopped soil suffered. It is believed that these plants are suffering in the same way as the acid choked plants in the raw peat cultures of the greenhouse.

That the apparent acid-choking may be in essence a nitrogen starvation phenomena is a possible explanation of the results of these two plantings. From the great stimulation in the growth of the weeds in the ploughed tract as well as on general grounds it is inferred that nitrification has gone on much more actively in the

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Greenfield, June 30, 1909

Eleventh row (con.) (con. 5)
ploughed than in the unploughed area.
Nitrification would be still less in the still more acid conditions of the newly chopped soil.

In the ideal field plantings of next year it is good three kinds of soil should be tried, in good sized holes from which the original soil has been removed, (1) peat kept a year under cover, (2) new peat, (3) new peat with a small amount of manure added.

The best shade for plants just set out is pine branches, by far.

Twelfth row (Culture 49)
The plants of this row are in the same condition as those of row 11. Only two of the 21 in the row have made any new growth.

Thirteenth row (Culture 131)
Condition similar to rows 11 + 12, only 6 out of 22 plants showing any new growth, and the plants in moister spots having the leaves more purple or having lost more of them

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WASHINGTON, D. C. Greenfield, June 30, 1909
(Con. 6)

Fourteenth row (Culture 131)
The condition of these plants is much better than that of rows 11, 12, and 13, 16 out of 24 plants showing new growth and most of these good color also. It was this row 14 in which the branches were pruned back to about ~~one third~~ to one-third to one-half their length when planted out early in the month.

Fifteenth row (Culture 131)
Seventeen out of 24 show new growth.
The plants in this row also were cut back.

Sixteenth row (Culture 72 d)
Plants not cut back when set out.
Plant 5, from south. Leaves all shed, stems alive
Plant 15. Leaves all shed, stems alive below
Plant 17. " " " " " below
Plant 18 " " " " " "
Plants in this row ~~are~~ in much the same condition as rows 11 + 12, only 7 out of the 24 showing any new growth whatever and that mostly feeble.

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Greenfield, June 30, 1909 (Con'd)

Seventeenth row (Culture 72)

Twenty-five plants, all cut back. Nineteen have made ~~growth~~ new growth. Most of the plants that have made new growth have made it recently, ~~[illegible]~~ the leaves of the plants having first turned purple and the plants subsequently recovered from their weed-choking.

Eighteenth row (Cultures 44 [south 19] and 45 [no. 16])

Plants not cut back, 25 in number. Ten plants show new growth, mostly feeble. Plants resembling in condition rows 11 & 12.

Nineteenth row (Culture 44)

Twenty-four plants, not cut back. Nine show new growth, others like rows 11 & 12

Twentieth row (Culture 44)

Six plants, cut back. Five show new growth.

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[illegible], June 30, 1909 (Con. 8)

Plants set in 1909 in ground prepared in 1908.

Row 1, nine plants (Cultures 44 [2], 45 [2], 72 [2], 72A [3]) Plants all started new growth

Row 2, ~~(Culture 45)~~ 3 plants (Culture 45). Two have made new growth

Row 3, 2 plants (Culture 44). ~~One~~ have made new growth, ~~though~~ both look well

Row 4, 4 plants (Culture 45). all have made new growth

Row 5, 6 plants (Cultures 50 [5], 44 [1]). All have made new growth. Especially have the plants of Culture 50 make a vigorous growth.

Row 6, 8 plants (Culture 50). All have made new growth, in most cases vigorous.

Row 7, 6 plants (Culture 50). New growth, mostly vigorous, on all.

Row 8, 1 plant (Culture 50). New growth, vigorous

Row 9, 5 plants (Culture 50). New growth on four.

Row 10, 4 plants (Culture 50) New growth on three.

In all these ~~new~~ plants in rows 1 to 10, only an occasional plant was cut back. In not a single instance is a plant ~~really~~ conspicuously pimpled, or otherwise in bad condition, even though it has made no new growth.

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Greenfield, June 30, 1909.

The characteristic shrubs of the meadow are alder, willow, and *Spiraea salicifolia*, with *Vaccinium pennsylvanicum* and *Lycopodium complanatum* in the higher spots, and sphagnum and carices in the lower places.

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[illegible]

[illegible]

Row 1 from south.
Plant 1 from east, [illegible]
2 thrifty
3 [illegible]
4 thrifty

Row 2, all 4 thrifty, shoots [illegible] to 16 cm [illegible]

Row 3, all 3 thrifty

Row 4, [illegible]

Row 5 Plant 1 feeble, 2-4 thrifty.

Row 6, all 5 thrifty, Plant 3 [illegible]

Row 7 all 6 thrifty Plant 5 [illegible]

Row 8, [illegible] 5 thrifty, 6 rather feeble

Row 9, all 6 thrifty

Row 10, all 6 thrifty [illegible] plant 4, [illegible] feeble, Plant 2 26 cm above the mulch

Row 11, Plant 1 [illegible], plant 2 feeble, 3 [illegible]

Row 12, Plant 1 [illegible], 2 feeble, 5 feeble 3, 4, 6, 7 thrifty

Row 13, all 7 thrifty

Row 14, 5 & 6 feeble, rest [illegible] thrifty

Row 15, 1 & 2 feeble, 3 to 7 thrifty.

Row 16, 1 feeble, 2 to 7 thrifty

Row 17, all 7 thrifty [illegible]

Row 18, plant 1 with 2 [illegible] [illegible], 2 feeble [illegible] 3 to [illegible] thrifty.

(over)

Row 19, 1 thrifty, 2 feeble, 3 to 8 thrifty

Row 20, 1 & 2 rather feeble, 7 & 8 dead, 3, 5, 6, ? thrifty.

Row 21, 1 dead, 2 thrifty, 3 feeble, 4 dead, [illegible] 6 feeble, 7 thrifty, 8 dead.

Dead 5

Row 22, ~~1 dead, 2 thrifty, 3 feeble, 4 [illegible] 5 dead~~ 1 thrifty, 2 dead, 3 thrifty, 4 feeble 5 thrifty, 6 dead, 7 thrifty, 8 feeble

Row 23, 1 dead, 2 & 3 thrifty, 4 & 5 dead, 6 thrifty, 7 dead, 8 feeble.

Dead 14

Feeble 20

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Greenfield, July 4, 19[illegible]

Blueberry [illegible]

Plant of Culture 45, — Row 1 (Plant 6), had two [illegible] [illegible] to-day. [illegible]. Two more buds nearly ready to open.

Plant of Culture 50, Row 8 (Plant 11) [illegible] [illegible] [illegible] pollinated.

Greenfield, July 6, 19[illegible]

Plant of Culture 45, pollinated July 4, had [illegible] [illegible] [illegible] pollinated to-day. These four are all the flowers the plant will bear this year.

Plant of Culture 50, pollinated July 4, had lost its pollinated flower to-day.

Greenfield, July 8, 19[illegible]

Plant 12, row ~~D~~ 10, has the largest of its nine berries turning purple to-day.

Washington July 11, 1909

Culture 154. Forty cuttings from the Brooks bush, placed in the ordinary yellow sand of the propagating house by me to-day. The cuttings were made by me at Greenfield July 9, late afternoon, trimmed, the butts placed in a ball of wet sphagnum, and the whole wrapped tightly in paper. They were kept shaded and as cool as possible until placed in the propagating bed. In trimming the petioles were cut near the base. After placing in the bed the cuttings were covered with a large bell glass.

Culture 155. Twenty cuttings, Gould bush, put in white propagating sand to-day. Cuttings made July 9 in the late afternoon, not trimmed, placed in moist not wet sphagnum in a box, wrapped, put in the shade and kept as cool as possible till to-day. The cuttings were

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July 15, 1907

trimmed with a knife and placed in a 10-inch washed pot prepared as follows: crocks at the bottom, then about 1½ inches of fiber from kalmia peat, then about 4 inches of white glass sand. After the cuttings were put in and watered, the pot was covered with a window glass, and the whole kept shaded in the propagating house.

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Washington, July [illegible] '01.

Cotton 153. The tallest plant measured to-day 480 mm. (19 inches) in height of stem.

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Washington July 13/1909.

Culture 156. Twenty-six cuttings from the Brooks bush, made July 9, 1909, not trimmed, wrapped and treated till opened like the cuttings of Culture 154. To-day they were put in white propagating sand by Mr. Gages, in a pot, exactly ~~treated~~ like Culture 155, except that the leaves taken off were broken off, not cut off.

Culture 157. Twenty cuttings from the Stanley bush, taken July 9, trimmed, the butts placed in wet sphagnum, the whole wrapped tightly in paper and kept in cool shade till to-day, then placed in white glass sand in a pot like Culture 156.

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July 13, 1908.

Mite disease

A pathological phenomenon observed last summer on the aquarium plants has developed now on some of the window sill cultures. The leaves of growing shoots become semi translucent or "watery" in appearance, remain small, develop a faintly rusty color on the lower surface, tend to become slightly cockled, and sometimes turn brown and wither. The shoots bearing such leaves evidently suffer from lack of nutrition.

It turns out upon examination to-day that these leaves are infested with a minute animal, probably a mite, much smaller than the red spider. The plants will be submitted to the entomologist for examination.

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July 13, 1909

Culture 10. A [illegible] came out [illegible] from one of the [illegible] cuttings and is now 2.3 cm above the sand.

Culture 12?. The latter graft has made a shoot from the third bud from the top of the original scion 14 cm. in length. The first branch from the scion, 1.6 cm. long has made no new start. The other scion has continued growth from its ultimate bud, now reaching 8 cm. in length.

July 14, 1909.

There is as yet no ~~tendency~~ indication in any of the cultures, either of 1907 seedlings, 1908 seedlings, or cuttings, of the differentiation of flowering buds, for next spring blooming, on any of the new twigs or shoots of out door growth. This new growth is having a remarkable development, ~~some of~~ the new shoots known to have grown wholly since the plants were put in the cold frame, reaching as great a length as ~~being~~ 350 mm. ~~in length~~ (on the tallest plant of 153). ~~Very few~~ Some still longer shoots, 400 mm. in a plant of 89, probably developed during this period. Very few of these shoots and twigs have ~~ceased~~ withered their tips. Most of the ~~t~~ resting flowering buds that had developed ~~on~~ the plants while still in the greenhouse with the cool night temperatures of the late winter have withered. Several such are noted to-day on Culture 43, on which only one flower is known to have been produced. An occasional plant of the 1907 seedlings is still in flower.

Culture 17A. Tallest plant 470 mm high, erect, the tip recently withered.

Culture 153. Tallest plant 490 mm. high, not still withered.

July 1st '96.

Culture 133. In the [illegible] cuttings [illegible] a small [illegible] [illegible] [illegible] [illegible] that it had been [illegible] the [illegible] [illegible] [illegible] [illegible]. They were [illegible] [illegible] [illegible] [illegible] [illegible] [illegible].

Two of the small plants are [illegible] new buds, [illegible] to the [illegible] [illegible] [illegible] cuttings, which [illegible] [illegible] small leaves, [illegible] [illegible] [illegible] [illegible] length.

Culture 43. Plant A4 has set one green fruit, from a flower [illegible] [illegible]. This is the only one of the 1895 seedlings here at Washington known to have flowered.

Culture 55. One of the plants used to-day as a source of [illegible].

July 14, 1909

Culture 170. The ripe berries, several of them were picked from the plant to-day.

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July 17, 1909.

Mite disease.

Mr. Banks says that the mite recorded on the windowsill plants July 13, 1909, is a Tarsonemus, perhaps the same as the undescribed species found on seedling blueberries last winter. He will examine the animal and determine its identity.

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Lanham, Md. July 18, 1909

Vaccinium atrococcum although only an occasional shoot is ~~still~~ growing, has not as yet differentiated any ~~flowering~~ buds. Although the Azaleas have begun to make their buds.

One shoot, from a "stump" made by cutting off a 3/4 inch stem last winter, has made a length this season of 36½ inches and is still growing, with several branches above. The shoot was [illegible] in [illegible]

The Kalmia hedge in front of Collins' house was

July 17, 1909

Culture 154. The cuttings, which were a little dried, enough to wilt the young secondary leaves that had formed on some of them, on the morning of July 17, look badly this morning. In probably more than half the cuttings the leaves are purpled on the midrib

Culture 150. One of the roots dug up to-day. Apparently still alive within, but brown at both ends and with no callus.

July 12 '07.

Window sill cultures. Moved down all the window sill cultures to the coldframes except 41A, 140, 145, and 113. ~~[illegible]~~

Culture 42. Brought up a plant of this number that had been in the coldframe, and earlier (during the winter) through in sphagnum in the greenhouse. It had produced in early spring four terminal racemes, the green fruits of which are now approaching the ripening stage

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July 20, 1914

Culture 64. The six plants sent to T. N. Vail, Lyndon, Vt., to-day have the following height.

370 mm.
342
335
372
350
365

July 21, 1909

Culture 154. It turned out yesterday that the cuttings have been exposed to sunlight in early morning and late afternoon for two or three days at least. The sashes were therefore given a light coat of turpentine and white lead yesterday. It is probable that nearly all the cuttings are ruined. The puckering noted earlier is increasing; there is some yellowing, and the leaves are falling.

July 22, 1937

Culture 135. Twenty plants, repotted in 4-inch washed pots, crocks at bottom, then drainage cushion of coarse kalmia peat, then mixture of rubbed (1/4 inch sieve) kalmia peat 9 parts, glass sand 1 part, about half crocks between old ball and sides of pot. Plants in thumb pots (27) all alive, four however discarded as too small, the remainder 3 to 7 cm. high, in order of height, with about 20 to 25 leaves, the larger leaves reaching 5 cm. in length. Two plants taken out for specimens. One plant only has branched, others all growing from terminal bud.

Culture 137. All 35 plants alive, from 2.5 to 7.5 cm. high. Best plants round the outside of the flat. Leaves up to 5 cm. long

Culture 135. Four plants dead, one gone, 47 alive, two others discarded. Remaining 45 1.5 to 4 cm. high, leaves about 12 to 20, up to 3 cm. long.

July 22, 1907.

Culture 138. All forty plants alive, very variable from 2 to 8 cm. high, leaves up to 5.2 cm. Plants not so good on the average as 134.

Culture 139. Out of 28 plants, three dead, four more discarded as too feeble. Remainder 2.0 to 8 cm high, leaves up to 4.5 cm. long. They do not average so good as 135.

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Culture 134. Thirty plants, July 27, 1901, infested July in the same manner as 135

July 23, 1908.

1907 seedlings in the frame measured to-day as follows:

Culture	22	563	mm.
	70	633	"
	42	553	"
	8	540	"

1907 seedlings discarded to-day from the frame

Culture	70	~~36~~ 40	plants
	71	3	"
	42	4	plants (3 <u>42</u> and 1 [illegible])
	27	2	"
	22	3	"
	21	1	"
	14	2	"
	9	1	"
	8	1	"
	6	1	"

July 23, 1903

Culture 135 A. Ten pots taken out of Culture 135 and marked 135 A. The selection was made pair by pair so that plants of like vigor would be represented in the two cultures. Culture 135 A is to be watered with 1/10 per cent nitrate of soda after the roots have had a week to begin growth.

Culture 134 A Fifteen plants taken out of Culture 134 pair by pair so that the two cultures contained plants of like vigor. To be watered with 1/10 per cent nitrate of soda.

Culture 133. Four of the sap plants (those potted June 1) are now making growth. Two of the four have made branches about 2.5 cm. long and ~~[illegible]~~ browned their tips

Culture 155. Cuttings in good condition. Only 1 leaf showing any yellowing, none dropped.

Culture 157. Cuttings in good condition. Only two leaves show yellowing, none dropped.

Culture 156. Several leaves yellowed and a few dropped. Cuttings [illegible], too much crowded in the pot. [illegible] [illegible] of [illegible] of [illegible] [illegible]

Lanham Md July 25 1909.

Scofield seedlings of 1908 examined to-day. One (the northeasternmost) dead. Others growing up to 40 cm high.

Polycodium stamineum. Unripe berries found up to nearly 15 mm. diameter.

Gaylussacia baccata. Berries beginning to ripen. A few taken to raise seedlings from.

Vaccinium atrococcum. Berries taken to-day from a vigorous bush for raising seedlings for grafting stock.

Polycodium stamineum. A bush found on the trail from Cook's to Brown's with berries up to more than 16 mm. in diameter. A few of the largest berries picked from the bush measured as follows:

1 berry 16-17 mm.
1 " 15-16 "
7 berries 14-15 "
6 " 13-14 "

Bush marked with a zinc tag.

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July 26, 1909.

[illegible]

Sown July 22, 1909, by Mr. Oliver.

Soil peat mixture 2 (from pot of Culture 135)

Sharp silver sand 1

Dried sifted leaf

sphagnum small amount.

Seeds from Greenfield, July, 1909.

Culture 135. Repotted July 23, 1909 in 4-inch pots, peat 4, sand 1, with broken crocks between ball and pot. Twenty plants

Culture 138. Repotted July 23, 1909 4 inch pots, pure kalmia peat, with crocks between ball and pot, 29 plants.

Culture 139. Repotted July 24 & 26, 1909, thirteen plants, pure kalmia peat, with crocks.

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WASHINGTON, D. C. July 26, 1909

Cultures 134 A, 135 A. Watered with 25 cc. each of a 1 to 1000 solution of nitrate of soda.

Same July 27.

28.

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July 23, 1909.

Culture 154 Fourteen cuttings blackened, removed today. Of the remaining 11 7 have lost their leaves, 4 have still one or more leaves.

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July 28, 19[illegible]

Culture 89A One of the plants has reached a height of 560 mm. the tallest ~~the~~ of the 1908 seedlings. The plant however is "drawn" from growing in the shade, and is affected with the mites.

~~Culture #37A~~

July 28, 1909.

Culture 15 + Sixteen cuttings of Leucothoe racemosa, from the lower edge of the Scofield-Collins woods at Lanham. Made this morning. Placed in the blueberry cutting bed. The plant is now sending out its racemes for next years flowering.

Culture 64. Twenty-five plants taken out of the cold frame to-day and repotted in six inch pots in peat 1, sand 1. with a [illegible]. The height of the plants is as follows

375 mm.	340	275
350	310	345
310	270	350
355	280	320
330	310	
375	405	
350	380	
295	360	
355	220	
365	375	
305		

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July 28, 1909.

Culture 159. Gaylussacia dumosa. Seeds ~~planted~~ to-day in a flat with a layer of coarse kalmia peat at the bottom and a mixture of 5 parts glass sand and 6 parts ~~by bulk~~ finely sifted kalmia peat, by bulk. Collected at Lanham July 25.

Culture 160. Vaccinium atrococcum. Seeds sowed to-day, collected at Lanham July 25; same flat and soil as 159.

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July 29, 1909.

Culture 161. Rhododendron maximum. Seeds from Beadle, Biltmore, received last winter, sowed to-day in a flat with coarse kalmia peat drainage below and a soil of finely sifted kalmia peat 2 parts, glass sand 1 part.

Culture 162. Leucothoe catesbaei. Seeds from Beadle, Biltmore, last winter, sowed to-day like Culture 161, same flat.

Culture 163. Azalea lutea. Seeds from Beadle, Biltmore, last winter, sowed to-day like Culture 161, same flat.

Culture 164. Leucothoe racemosa. Seeds from Beadle Biltmore, last winter, sowed to-day like Culture 161, same flat.

July 19, 1911,

Culture 153. Six cuttings are denuded [illegible] [illegible] leaves.

Culture 155. Some of the cuttings shrivelled, but the leaves [illegible] falling in

Culture 157. A few of the leaves somewhat yellow, but the condition of the cuttings in general good.

July 29/1917,

Blueberry propagating bed.

July 29 Max. 103°

30 Min. 73°

July 30 Max. 85°

~~[illegible]~~ Min. 77°

July 23, 1907.

Cutters 165 [illegible], 1[illegible] cuttings from Lanham, Md. [illegible] cutting frame.

Cutters 166. ~~Polycodium~~, 10 cuttings from the trail Castle to [illegible], Lanham, Md. Bush bears berries up to 15-17 mm.

Cutters 167. Vaccinium atrococcum, 11 cuttings, from Lanham, Md. bush [illegible] of Scofields woods beside road newly cut

Cutters 168. Polycodium, 18 cuttings, from Scofields woods, bore berries up to 16-17 mm

Cutters 157 Six plants repotted to-day in 4 inch pots, peat & sand 1.

Cuttings 178 [illegible], [illegible] pots [illegible] [illegible] out [illegible] of [illegible] to-day.

Cutters 120. Two shoots of last winter cut off, leaving only the two grafted branches, ~~these~~, new growth of these 100 and 190 mm. long.

Linville, N. C., Aug 1911.

Vaccinium pallidum. One a type I have a year ago last fall, and therefore in its second year of new growth a fair amount of berries on some, quite enough to warrant picking. The year is a poor one. These berries average larger than on old bushes, 10-11 to 12-13 berries. The bushes are 2 to 3 feet high.

The new wood is distinctly showing the difference between flowering and leaf buds for next year.

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TAXONOMIC AND RANGE INVESTIGATIONS
Washington, D. C.,

Linville, N.C., Aug. 8, 1909.

"Wild gooseberry". *Polycodium*
Sometimes made into preserves, not poisonous.

"Huckleberry", in particular "blue huckleberry". *Vaccinium pallidum*

"Hog huckleberry". *Gaylussacia*, apparently *G. baccata*.

Vaccini

August 7, 1909

Culture 169. Thirteen cuttings placed in the north frame cutting bed yesterday by . These are from the Grandmother bush

Culture 170. Twelve cuttings, Grandfather bush. Put in the north cutting bed to-day by myself.

August 9, 1907

Culture 154. All but 14 cuttings have lost their leaves, (blackened from the base up) and been removed. Of the remaining 14, eight still retain one or more leaves, six are leafless and green above ground. The contamination, except in the case of very soft wood, comes from the cut surface of the cutting and works upward, the part above the surface of the sand remaining green till all below is blackened.

The six leafless cuttings are dug up and removed to-day. All were blackening from the base upward.

Culture 158. Leucothoe. Has lost no leaves as yet. All looks in good shape.

Culture 165 Pieris mariana. All the leaves have dropped. Most of the wood appears to have dried up. Five cuttings left in.

Culture 166. Polycodium. Some leaves blackening in part, but mostly staying on.

Culture 167. Leaves beginning to fall. Two leafless cuttings removed. [illegible] ~~dead~~ turning brown on one side to the base.

Polycodium. August 9, 1909.

Culture 158, Leaves nearly all blackened and fallen

Culture 155. The wood on these cuttings ~~is~~ is slender and has a somewhat withered look. One cutting removed today was blackened from the base to the surface but had not yet dropped its leaves

Cultures 158 A, 135 A. Each pot given 25 cc. of 1/10 solution nitrate of soda.

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Aug. 9, 1908

Polycodium melanocarpum (Drayton no 3)

Berry 1	, mature	seeds	24.
2	"	"	28
3	"	"	35.

August 10, 1909

Culture 171. Polycodium Crayton no 1. Six root-stem cuttings, placed in the propagating frame to-day.

Culture 172. Polycodium Crayton no 1. Eight twig cuttings, placed in the propagating frame to-day.

Culture 173. Polycodium Crayton no 2. Five root-stem cuttings, placed in the propagating frame to-day.

Culture 174. Polycodium Crayton no 3. Six root-stem cuttings placed in the propagating frame to-day.

Culture 176. Dendrium prostratum. From Grandfather Mountain, N.C., Aug. 1909. Three small rooted plants, potted Aug. 6 in kalmia peat 9, sand 1, in 4, 5, & 6 in pots.

Culture 177. Dendrium prostratum. From Grandfather Mt, N.C., Aug. 1909. Two plants potted Aug. 7 in [illegible] kalmia peat 9, sand 1, 5 inch pots.

10 A.M. Aug. 10, 1917.

Thermometer yesterday:
Propagating bed min. 73 6 A.M. Aug. 9
max. 78 6 P.M. Aug. 9.
Out doors min. 76 ~~5~~6 A.M. Aug. 10.
max. 94 4 P.M. Aug. 9

August 10, 1909.

Culture 77. Five plants, of the following height

50 mm.
53 "
48 "
46 "
26 "

Culture 79. Three dead, two alive besides check
Check 80 mm.
Others 30 "
30 "

Culture 73.
225 mm.
160 "
230 "
245 "
295 "
230 "

Culture 74. None alive

Culture 75.
263
155
210

Culture 75 A
368
295
215 variegated
220 pinched back once

Aug 10, 1909.

Culture 76

245 mm

70 "

203 "

Culture 77A

~~7~~ 163 mm.

Culture 78

215 mm. Peat water Apr. 7, 11, 19, 29 etc.

Culture 78 Two smallest

70 mm.

50 mm.

Culture 80

235

310

155

240

215

August 18, 1909

Culture 178. [illegible] [illegible]

Thirty-[illegible] cuttings from [illegible] Mountain, N.C., Aug. [illegible] Put in [illegible] — a 6-inch pot Aug. [illegible] and kept under a bell glass.

Maximum heights (leaves and all) in seedlings of 1908, as follows:

Culture 55.	550 mm.	(growing)
	570 "	"
47	544 mm.	(stopped)
47	565 mm.	(growing)
47A	530 mm.	(stopped)
43 B_2	515 "	(growing)
153	520 "	(growing)
55B	525 "	"
55 B.	545 "	"
87 A	640 "	(upcurved) [illegible]
56 A	505 "	(growing)
127	615 "	(stopped)
43	See other sheet of this date.	

27.5
34.5
1 "

August 10, 1909.

Acterus 43, Manure water test as follows.
Measurements over leaves ins [illegible].

M. B1 475 mm.
B5 447 "
M5 440 "
M. F4 350 "
D1 323 "
M. A4 520 "
D3 340 " a little brown
M. C4 573 " brown above, angle worms in lot
M. F2 572 " " " " "
B4 405
M. A3 543 " brown above.
B5 375

Manure water — Average height of manured plants 507 mm.

A3	543
C4	573
F4	350
B1	475
A4	520
F2	572
	3033

No fertilizer — Average height of plants not manured 422 mm.

B4	405
B5	375
D1	323
D3	340
B5	447
M5	440
	2530

T. R. I.

Rhododendron leaf from
[illegible]
[illegible] 1.6

Aug. 12, 1909.

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August [illegible]

Culture 17 A. This is the mark given to a plant of Culture 17, which in the cold frame, plunged in sphagnum, has ripened berries up to a diameter of $12\frac{66}{100}$ mm. The plant has been brought up to the window sill and placed in a larger pot with sand between

Aug 2 [illegible]

Cutting 179. Eighteen cuttings from the Brooks bush put in the propagating frame to-day. Some were a little too long on the road.

Cutting 180. Sixteen cuttings from the Brooks bush put in sand in a 9-inch pot by Mr Gage.

Aug. 2, 1912

Cultures 1776-1781. [illegible] [illegible] each of [illegible] [illegible] [illegible].

Culture 181. A plant of Culture 42 (Culture 3) budded yesterday by Mr. Boyle with one bud from the Brooks bush. The 6 inch pot replaced in the sphagnum in the old frame.

Culture 182. A plant of Culture 11, budded yesterday by Mr. Boyle with 1 Brooks bush bud.

Culture 183. A plant of Culture 42 (Culture 3), budded yesterday by Boyle with 1 Brooks bush bud.

Culture 184. A plant of Culture 13 budded yesterday by Boyle with 1 Brooks bush bud

Culture 185. A plant of Culture 19 budded yesterday by Boyle with 1 Brooks bush bud. Plunged in sphagnum in a larger pot.

Culture 186 A plant of Culture 42 budded yesterday by Boyle with 2 Brooks bush buds. Plunged in sand in a larger pot.

Culture 187 A plant of Culture 42 budded yesterday by Boyle with 2 Brooks bush buds. Plunged in sphagnum in a larger pot.

[illegible]

4187

26) 10361 (395
78
246
234
121
104
17

Average height 395 mm.

435
448 8846
460 ~~465~~
370 325
365 335
350 275
370 340
355
8846 10361
4187

[illegible] height [illegible] as follows, [illegible] leaves.

2807

545 · 512 7371
370
375 →
470 · 335
2807

7371

26) 11171 (429
104
77
52
251
234
17

11171

Average height 430 mm

August 14, 190[illegible]

Culture 55 Measured today, leaves and all as follows:

	687	5041	9468
207	422	305	[illegible]
480	662	125	335
687	240	316	320
	320	410	420
	475	435	370
	247	500	440
	360	445	
	270	480	
	368	445	
	455	310	
	385	578	
	5041	9468	11798

$3.0\overline{)1179.8}$ 393

Average height 393 mm.

After measuring, 2 small plants thrown out.

Culture 55 A Measured today, leaves and all, as follows:

	1610	5880
420	475	195
390	330	348
230	405	345
430	425	325
140	440	7093
1610	425	
	460	
	420	
	365	
	270	
	315	
	5880	

$2.0\overline{)709.3}$ 355

Or, with Culture 153 (see Aug. 16)

$26)\ 9{,}925\ (382$

Average height 355 mm. or in conjunction with 153, 382 mm.

After measuring six small plants thrown out.

Culture 5 B, Measured today, leaves and all, as follows:

	3088	7721
270	[illegible]	375
410	[illegible]	350
435	420	8446
480	520	
530	345	
505	410	
458	575	
3088	493	
	360	
	410	
	375	
	7721	

$2.0\overline{)844.6}$ 422

Average height 422 mm.

Aug. 16, 1917

Culture 181. Cuttings [illegible] Aug. 6

Culture 182. [illegible] Aug. 11

Culture 183. [illegible] Aug. 11

Culture 184. [illegible] Aug.

Culture 178. Tradescantia [illegible] cuttings. The leaves [illegible] in good shape, but [illegible] cuttings [illegible] decayed at the base. The cuttings had not been watered [illegible] but [illegible] rooted.

Culture 134A, 135A. Each plant watered with 25 cc. nitrate of soda solution 1/2 %

August 16, 1909

Culture 153. Plants measured to-day as follows:

465
565
500
512
450
340

$6 \overline{)2832}$
472 mm average.

Culture 188. A plant of Culture ~~67~~ 70, seedling of 1907, budded to-day by Boyle with a bud from a* cutting taken from Culture 169, *Vaccinium pallidum*

Culture 189. A plant of Culture 6, seedling of 1907, budded to-day by Boyle with a bud from a cutting taken from Culture 169, *Vaccinium pallidum*.

(over) > Culture 190. A plant of Culture ~~70~~ 17, seedling of 1907, budded to-day by Boyle with ~~[illegible]~~ one bud from a leafless cutting taken from Culture 170, *Vaccinium pallidum*.

Culture 191. A plant of Culture 8, seedling of 1907, budded to-day by Boyle with two buds from a leafless cutting taken from Culture 170, *Vaccinium pallidum*

Culture 189A. A plant of Culture 7, seedling of 1907, budded to-day by Boyle with a bud taken from a cutting of Culture 169 *Vaccinium pallidum*

Culture 189B. A plant of Culture 42 (Cul. Tr. 4), seedling of 1907, budded to-day by Boyle with a bud taken from a cutting of Culture 169 *Vaccinium pallidum*.

August 17, 1909.

Culture 127. One plant 635 mm. long leaves and all
Culture 59A. " " 640 mm " "
Culture 56A. Plants measured to tip leaves and all, as follows

	2150	5545	9565	13955
	470	355	395	455
	355	370	350	370
	(nearly hybrid)	390	380	390
	390	275	475	475
	460	300	570	(leaves not measured)
370	(nearly hybrid)	425	430	~~337~~
375	315	500	420	15625
395	355	465	250	
220	320	250	510	
475	400	275	320	
350	375	415	450	
2150	5545	9565	13955	

Culture 56. Plants measured to tip, leaves and all as follows

	2135	6565	10915
	360	420	380
	345	400	400
	390	395	420
	410	365	[illegible]
	[illegible]	445	410
337	315	175	430 (growing end)
363	475	450	375
395	385	525	300
425	410	415	13830
220	525	460	
395	390	300	
	425		
2135	6565	10915	

Aug. 17, 1909.

Culture 182. About 24 root-seen cuttings of ~~Vaccinii~~ Polycodium melanocarpum ~~f~~ (Crayton's No. 3) placed in the cutting bed by Mr. Gages ~~[illegible]~~ to-day; in the propagating house.

Aug. 18, 1909

Culture 105. Ten plants taken out to-day and numbered 105 A.

Culture 105 A. Ten plants taken out of Culture 105, pair by pair, to be treated the same except watered with 1/10 % solution of nitrate of soda. Each 25 cc. to-day.

Culture 156. Now 14 cuttings, nearly all callused, transferred to propagating bed to-day by Mr. Gages. Bell glass.

Culture 155. Now 15 cuttings, ~~all~~ callused, transferred to propagating bed to-day by Mr. Gages. Bell glass.

Culture 157. Now 10 cuttings, all callused, transferred to propagating bed to-day by Mr. Gages. Bell glass. One rooted cutting potted as 157 A.

August 8, 189[illegible]

Culture 68. [illegible] plants taken just as Culture 67 A. One small plant thrown away, remaining [illegible] measured as follows, leaves and all.

435 mm.	2470	
	405	
360	470 ~~308~~	
390	330	
375	335	
405	410	
465	385	
2470	4805	

12) 4635 (386
36
103
96
75

4635
170
12) 4805
400

Average height ~~386~~

400 mm.

Culture 68 A. [illegible] plants [illegible] of Culture 68, pair by pair, to the [illegible] [illegible]. Measured as follows.

390 mm.	2485	
	~~440~~ 360	
370	375	
385	405	
405	405	
360	350	
525	420	
2985	~~4770~~	

~~12) 4710~~
~~409~~

Average height ~~409~~

395 mm.

12) 4740 (395
36
114
108
60

[illegible] 100 [illegible] 150 [illegible]

August 18/08

Culture 137 A. 2 cuttings of Culture 137 already rooted. Potted in a thumb pot in [illegible] soil 3, glass sand 1. Bell glass.

Culture 180. Sixteen cuttings transferred from pot to propagating [illegible] by the [illegible]. Bell glass.

Culture 138. Fourteen plants taken out to bag as 138A.

Culture 138A. Fourteen plants taken out of 138, to be watered with solution of [illegible] 1/10 %. Plants of 138A not quite as good as 138. Each 35 cc. to bag.

Culture 139. Six plants taken out as 139A

Culture 139A Six plants from 139, [illegible] there to be watered with [illegible] [illegible] 1/10 %. Each [illegible] to bag

Aug. 8 '99

Culture 422, Returned to L. cell frame yesterday

Culture 424 Same

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August 18, 1909

Sodium nitrate used on un-
[illegible] sill cultures. Two liter bottles 1/10% as
follows: July 31

Aug 5

Aug 8

10

12

17 bottle filled but none used

Applications discontinued to-day.

Ferric nitrate, 2-liter bottles as
follows: Aug 2

8

12

August 19, 1909

~~Portland, Or.~~

~~Sept. [illegible]~~

Mr. M. W. Gorman told me at Portland, Or. on Sept. 17, 1908 that at his old home at Douglas, Renfrew County, Ontario, some species of low blueberry grew and fruited in abundance on limestone soil. Write to Michael P. Gorman there for specimens.

August 17/07

Epigaea repens. About 8 seeds have germinated. The seeds were ~~sowed~~ about July 14, 1907, from my farm at Springfield, N.H.

Culture 169 [illegible] smooth – with buds

Culture 170 [illegible] heavy with buds

Smithsonian bulbs. [illegible] of the different colors of [illegible] flowering bulbs. All the bulbs are of the [illegible] form [illegible] [illegible] [illegible]

Lanham, Aug. 20, 1909.

The wild plants of Vaccinium atrococcum have begun to form their flowering buds for 1910. They do this through growth develop-ment from the ordinary leaf buds already formed in the axils of the upper leaves of the twigs. The two sharp scales of these ordin-ary buds, on this plant already turned brown, are pushed apart by the grow-ing tissue and the many scaled fat bud containing the flower buds proceeds to develop, the two original scales remaining on the outside of the bud. Specimens collected.

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TAXONOMIC AND RANGE INVESTIGATIONS.

Washington, D. C.,

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF PLANT INDUSTRY,
WASHINGTON, D. C.

August 22, 1917.

Wild seedlings, probably of Vaccinium atrococcum, in sandy moist mossy soil on a north slope, ~~by~~ a spring near Lanham, Md. The spring is on the east side of the Pennsylvania railroad south of Lanham station, on the west facing hillslope on the east side of a wooded draw draining to the south.

The small seedlings, of which 33 are preserved, grew in one tuft not over an inch in diameter. In most of them the cotyledons are brown, in a few still green. The plants bear from 3 to 7 leaves above the cotyledons, almost all of them still green. The axis is in no case branched. The plants vary in height from 1 to 2.5 cm. They are evidently from seeds that germinated last spring.

Of the 4 older branched seedlings, 7 to 9 cm. high, one, bearing the dead stem of the first year, is clearly at the end of its second year. The others may be third year seedlings.

These seedlings grew underneath a bush of Xolisma ligustrina, but they are believed from their pubescence to be those of Vaccinium atrococcum.

August 23, 1909

Culture 176. Bryonium. The largest plant, ~~shedding~~ *myby's-shed but* shedding and browning its leaves, is possibly dying, the other two all right.

Culture 177. Both doing well.

Culture 178. Dendrium. Cuttings all look well on top. Nine taken up, of which one had the stem brown and dead throughout, while the others had only the base brownish and brownish. These eight were reset and placed. Pot removed to propagating frame under shade of sash.

Epigaea repens. Many plants germinating this morning. Pot transferred to the propagating frame and placed close to the glass, the paint being rubbed off.

Culture 185. Bud in good condition.

Culture 186. One bud dead, one alive.

180. Bud alive.

189. Bud alive

188A. Bud alive

188. Bud alive

191. Both buds alive

187. One bud dead, one alive, dead bud & branch above.

181. Bud alive

182. Bud alive ~~dead~~, bud bark above it dead.

Aug 2[illegible] '1[illegible]

Culture 83. Bud ~~green and~~ plump, ~~young~~ stem swelling above the tie. ~~Tye~~ Tye taken off by Boyle and retied.

Culture 84. Bud plump.

Aug. 23/1909.

Culture 193. Vaccinium pallidum Grandmother bush. Seeds sowed in a small flat in kalmia peat 7, glass sand 2, sifted sphagnum 2.

Lawton [illegible] Aug. 24, 1909

Bush 2, across the woodland from Bush 1,
Plant has made no flowering buds.
foliage rather light and nearly all
showing [illegible] injuries [illegible]
are at [illegible] to [illegible] half their length
[illegible] and [illegible] other [illegible]
These are to be compared with [illegible]

injuries tip on the [illegible]
Plant [illegible] stayed not buds.

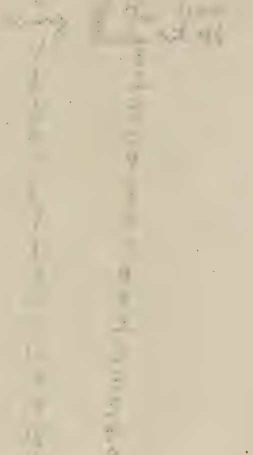
~~[illegible]~~

One [illegible] the [illegible]
flowering [illegible]
[illegible]

Lanham 101 (Aug. 24, 1907)

Pruning of [illegible] shoots

A branch of new long, with many side twigs which have definitely differentiated to flowering buds is trimmed to try so as to just remove the ends of the twigs just below the lowest flowering bud, to see if these flowering buds will be developed from the leaf buds still left on the twigs. The flowering buds, and leaves of one such twig are as follows beginning at the base



48

A neighboring branch 37.5' [illegible], to be used as a check on the development of flowering buds [illegible] flowering buds as follows

(Counted as 5)

53

August 25, 1909.

Smithsonian bushes. ~~South~~ North bush just beginning to expand its flowering buds for 1910, south bush not yet begun.

Culture 55B. Trimmed one tall plant to two stems, one of them still growing vigorously, this now 170 mm long. Can it be forced to very tall growth?

Temperature of propagating frame
Time 4:30 P.M.
Propagating frame 68° F.
Outside propagating frame 86°
Pennsylvania Avenue Weather Bureau kiosk 100°
This was a hot day, after several days of much cooler weather.

August 25, 1910

Culture 43 by Berry — this plant ~~[illegible]~~ is purple to-day

Culture 55 B. Largest plant 650 mm. to-day, leaves and all, apex 623 mm.; still growing.

Culture 140. The cuttings ~~had~~ showed a severe injury on Monday, August 23 as if they had been burned by the sun on Sunday. Only 3 cuttings are now alive.

Cultures 155, 56, 157. These showed some severe treatment on Monday, August 23, and now have many leaves partially browned or yellowed.

Culture 157a. The large cutting is all right.

Culture 88. Potted plant, [illegible] to [illegible] to [illegible] growing to-day. No growth in the other pots.

Culture 97. Eight cuttings [illegible] all [illegible] without leaves.

Culture 108 [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] them [illegible] [illegible] [illegible] [illegible] of

Culture 163. [illegible] [illegible] [illegible] [illegible] [illegible] light [illegible] [illegible] [illegible] [illegible] [illegible] [illegible], culture [illegible].

August 25/[illegible]

Culture 166 Polyandrium. Two still with leaves, four without. Of those removed some not callused.

Culture 167 Leaves gone in all but one, the other eight with wood blanched and lively, about half of them with a small callus.

Culture 168 Thirteen, leaves all gone, wood blanched above. No callus on [illegible] that were [illegible] of a [illegible] [illegible] at base. All left —

Culture 169, Seven remaining, [illegible] without leaves.

Culture 170. One remaining, without leaves, slightly callused. Others all turned [illegible] brown throughout.

Culture 171. Cuttings [illegible] above, callusing below, [illegible] on all [illegible].

Culture 172. Three still [illegible] leaves, [illegible] [illegible]

Culture 173. Cuttings [illegible]

Culture 174. [illegible] [illegible]

August 25 1909

Culture 177. Two trimmed cuttings taken out. Four without leaves left in. Fifteen with leaves left in, but leaves in some of these partly yellowed.

Culture 178. ~~[illegible]~~ Cuttings superficially all right, now 11 of the original cuttings 19 [illegible] [illegible]

Virginia frame. About 60 ~~[illegible]~~ seeds have now germinated.

Culture 120. Now laying down flowering buds for 1910 on both grafts.

Culture 43. Twelve pots, those at the front of the cold frame, trimmed back to the ten strongest stems, to see whether these plants will not lay down more flowering buds than the average of plants in this culture. The twelve plants are

D4 F1 J5 L4 N2 P2
D5 G4 I1 L5 N3 P1

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Soil solutions of equal acidity.

Peat 100 cc. | Sand 100 cc.

21 gr. [illegible] | 125 gr. 10% water

25 cc soil solution | 12.5 cc. soil solution

Therefore if the soil solutions are of equal acidity a sand soil will hold only one-tenth as much acid as an equal weight of peat soil, and one half as much acid as an equal bulk of peat.

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Experiments with 1907 seedlings.
After ripening wood and shedding leaves cut down
Repot ~~[illegible]~~ in 5 inch pots in ~~[illegible]~~
leaf ~~peat~~ ~~[illegible]~~ as follows.

Culture 6
7
8 Wash out soil
9 " " "
11
12 Wash out soil thoroughly.
13 " " " "
14
17
19
20 Wash soil out thoroughly
21 " " " "
22
27 Wash soil out thoroughly.
2a

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Culture 105 February 15, 1909, peat 6, leafmold 2, sand 1, loam 1.
134. March 25, 1909, peat 8, sand 1, loam 1.
135 March 26, 1909, " " "
138 April 5, 1909, pure kalmia peat
139 April 6, 1909, " " "

Cultures 105. Repot, 4-inch pots, peat 9, sand 1.
134 Repot, 4-inch pots, peat 9, sand 1
134A Half the plants of 134, equal in stature with those remaining in 134, to be watered with nitrate of soda solution

Cuttings 108 Peat 8, sand 1, loam 1
Feb. 18

" 18 109 Peat 5, leaf mold 3, sand 1, loam 1

" 19 110 Peat 3, leaf mold 5, sand 1, loam 1

" 19 110A Peat 2¼, leaf mold 3¾, sand 3, loam 1

Feb 20 111 Leaf mold 8, sand 1, loam 1

" " 111A Leaf mold 6, sand 3, loam 1

Cuttings 55 Peat 8, sand 1, loam 1
55A Peat 7, manure 1, sand 1, loam 1
55B Peat 10

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Sand without nutrient, tap water
" without nutrient, peat water
" without nutrient, humic acid
" with nutrient, acid
" with nutrient, alkline
Peat 8, sand 1, loam 1
Peat 7, manure, sand 1, loam 1

Bench space

South end,	1 ft. 10 1/2 in.	x 2 ft. 6 in.
	1 ft. 11 in.	x 2 ft. 5 in.
West side,	13 ft. 7 in.	x 2 ft. 9 in.
	1 ft. 3 in.	x 2 ft. 5 in.
East side,	24 ft. 1 in.	x 2 ft. 9 1/2 in.
	1 ft. 3 in.	x 2 ft. 6 in.

Repot in 6 inch pots, pure peat,

43

Repot in 6 inch pots

47 peat 6, sand 1, loam

47A " " "

55 " " "

55A peat 7, manure 1, sand 1, loam

55B pure peat

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Kingston R.I., August 2[illegible] 19[illegible]

Row of 45 plants of Vaccinium macrocarpon 4 feet apart, set out by Card in 1899. These were wild plants. There are about 3 vacant places and two places occupied by [illegible] plants. Growing all fruitfully [illegible] it is said.

S. C. Damon, assistant agronomist.

Many Card cuttings were turned over to him. Schermerhorn says that Adams the former [illegible] cutter it, said that none of Card's cuttings lived over a year.

People have never been interested in these berries Mr. Damon says, [illegible] because they do not grow large under cultivation.

Flowering buds for 1913 well differentiated

Hingham, Mass., Aug. 26, 1907.

Bluebery plants grafted by Edmund Hersey ~~more than 19 years ago, probably~~ 25 years ago. Now 6 feet high, with stems up to 2 inches in diameter. Mrs. Hersey believes they were grafted near the surface of the ground. The bushes have borne berries up to the present time. They are now considerably injured by an overgrowth of some neighboring grape vines.

Possibly published in Massachusetts Ploughman of which he was the agricultural editor more than 20 years ago. Not [illegible].

Look up article entitled "The highbush huckleberry", published in the Massachusetts Ploughman about June or July, 1884. This, in one of the scrapbooks, tells of his successful grafts, which he expected would bear in the following year. Also "The huckleberry crop", same journal August (next year?)

(over).

Also "Improving the highbush huckleberry", same journal apparently May 19, 1882

Also "The huckleberry crop", same journal, editorial, apparently about August, probably same year.

Also "Growing the blueberry", same journal apparently early in 1880. Refers to earlier articles in the same journal, and the newspaper discussion that followed

Also "The blueberry", same journal about June or July, 1880.

Also "Swamp blueberry", same journal, about February, 1881. "E. D." writing from Acton, Mass., tells of a high bush blueberry in his pasture with berries $1\frac{1}{2}$ in. in circumference

Greenfield, N.J., August 29, 1909.

Wild bushes of Vaccinium corymbosum ~~be~~ ~~[illegible]~~ lay down their flowering buds for next year. Apparently most of the flowering buds have become differentiated but their growth is only started, in some cases only begun.

The berries of corymbosum, pennsylvanicum & canadense are still holding on the bushes, but are withering on some bushes.

On the small areas of blueberry plants burned early in July, 1909, new shoots of pennsylvanicum have grown in abundance up to a length of about 15 mm. The majority are still growing though some have recently ended their tips. It is problematical whether these shoots will lay down flowering buds.

Greenfield, N. H. Aug. 29, 1908.

Orchard bush. This bush, which has been overlooked by the children thus far is loaded with black berries. One branch 25 cm. long, much branched, the twigs spreading to a width of 22 cm. has 108 plump berries and 17 partly dried ones, no green ones. Four of the berries are slightly in excess of 11 mm. diameter. All are dull black. It is Vaccinium amoenum. The 108 berries measure one tenth of a quart. The branch is 5 mm. in diameter, and is 5 years old. The new growth twigs ~~are~~ vary in length up to 5 cm., mostly 1.5 to 3 cm.

Cabot and I picked a little more than 2½ quarts off this bush today. None of the berries reached a diameter of 12 mm. though several almost did so.

The berries are sweet, but with comparatively little flavor.

Greenfield, N. H., Aug. 30, '09

Brooks bush. Sent budwood to-day to Swingle
and about 15 cuttings to Oliver.

Buds for ~~1909~~ 1910 flowering beginning
to be laid down.

Budded with a Brooks bush bud a branch
on a small bush about 4 feet high,
with a little 4-foot pine tree in its middle,
Bud tied ~~~~ in with brown cord and
the branch marked with a white
rag.

Took budwood for grafting on the
farm.

Budded with 1 bud each, three blueberry
bushes on my own farm (a) the big bush
by the alders, north of the swamp, (b)
the bush east of the Cabot bush on the
road to the orchard field, (c) the Cabot
bush itself. Each was grafted on wood
grown in 1908. Most of the plants would
not peel. The few that would, peeled most
easily on the north side of the twig
where the bark was still green, not
yet having begun to develop its cork-layer and to split its epidermis.
~~The~~ The buds were all from the Cabot bush.

Wareham, Mass., Aug 29, 1907.

Visited the cranberry bog and screening house of Mr. John M. Dodge about [illegible] mile south of Wareham on the road to New Bedford. Also talked with Mr. J. C. Makepeace.

Largest berry ever 18–19 mm., ordinary large ones 13–14 mm.

Barrel before screening room contains about a hundred quarts. Barrel commonly regarded as about three bushels.

Price commonly $6.00 per barrel.

Pickers by the day get 30 to 35 cents per hour. Pick about a bushel per hour, with a rake.

Day short, from dew to dew, about seven hours. On cool September days dew often begins to fall by five o'clock. Berries must be under cover at end of day.

Forty barrels per acre a ~~good~~ crop according to Mr. Makepeace, sometimes 100 or even 120.

Picking began August 25 on some bogs

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Wareham, Mass., Sept. 1, 190[illegible]

Visited Wankinco cranberry bogs with Mr. J. C. ~~[illegible]~~ Makepeace, ~~[illegible]~~ about six miles north of Wareham.

Made a soil section in a bog that had been in cranberries about 20 years.

Soil 1. Sand about 5 inches, the upper half of it stratified in about half inch layers the [illegible] [illegible] about between [illegible] [illegible] [illegible] branches, runners. This layer full of roots.

Soil 2. Fibrous peat loose and well aerated, full of roots, about 2 inches.

Soil 3. Black peat, fairly drained, with abundant root formation in the cracks. This about 10 inches deep.

Soil 4. Soft plastic peat, full of water, about 20 inches. This contains very few roots all brown and [illegible]. There are no cracks.

This year about 25 to 30 barrels per acre the crop promises to be.

Flood from December to May or early June, some of the lower parts of the bog 4 feet under

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Wareham, Mass., Sept. 1, 1907

Turfing ax, B[illegible] + Sons, [illegible]
Messengman's hoe.
or
Hauler Bought one of H. R. Bailey, South Carver, Mass. 1.25

"Barrel to the square rod" is the cranberry man's ideal of a maximum crop. Mr. Makepeace showed me a patch of late berries that he thought would go a hundred barrels per acre this year.

Drainage ditches about 2½ feet wide by 2 feet deep.

Best cranberry lands characteryzed by an original growth of "brown brush", Chamae daphne calyculata. The root mat of this ~~being~~ having been taken off there remains, in the area examined, about 3 or 4 inches of fibrous peat, then the black peat.

Sulphate of iron killed fern and [illegible], did not injure cranberry.

An all-round fertilizer used on most of the land, no manure.

Picking [illegible] [illegible].

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Wareham, Mass., Sept. [illegible] 1909.

One of the [illegible] women once picked a hundred bushels in an eight hour day.

Costs $400 to $500 an acre to buy and put land into cranberries.

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Mr. Peyton [illegible] Wareham, Mass. Sept. 2, 1909

Cranberry preparation

$300 to $350 for making an acre of wild bog into cranberry bog, including ditching, draining, planting and everything.

Cost of land $40 to $50.00 per acre

Good cranberry bog worth about $1000 per acre.

Dodge's bog.

Measure holds six quarts. Got 8 cents, hand-picked, 7 cents with "snapper" or "snapping machine".

Mr. [illegible]. Cost on his bog $150 per year, [illegible] turf and sand, that is $[illegible] an acre.

Once a neighbor used some 2 or 3 year old turf to fill a low place in a bog, the ~~[illegible]~~ [illegible] were of excellent quality and more berries than he ever saw before, but the berries did not keep.

Ditches 2 feet deep, 2 feet wide at bottom, 3 feet wide at top.

Fourteen measures per level barrel, a hundred quarts per packed barrel.

Paid $40.00 sand six acres last year, light sanding.

Wareham, Mass., Sept. 2, 1909

Area about to ~~now~~ being utilized for a cranberry bog. Vegetation as follows, in the order of abundance.

Clethra

Gaylussacia baccata

Chamaedaphne calyculata

Kalmia angustifolia

Vaccinium corymbosum

Myrica cerifera

Azalea

Gaylussacia dumosa

" frondosa

Ilex ?

Acer rubrum

Pinus strobus

"Scoop," like a large blueberry rake with teeth more than half an inch in diameter, said to be used only on old bushes that need replacing. It tears the bushes up badly.

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Wareham, Sept. [illegible] 190[illegible]

Weeding may cost almost nothing, known to be as low as $1.50 an acre in some cases. First two years of weeding may cost $100.00 an acre, but ~~must~~ should be done well whatever the cost.

Most picking to commence next Monday, Sept. 7.

Sand may be coarse or fine, coarse best. Clay bottom (one which causes [illegible] to [illegible] out [illegible] [illegible]). An elimination of surface sod in itself does no harm, but it usually means weed seeds, and weed seeds mean heavy expense for weeding.

"Swamp huckleberry", or highbush blueberry, roots have to be very thoroughly cleaned out of a cranberry bog, for the bushes grow and thrive under the culture followed for cranberries, even when submerged with water from December to May, to a depth of three feet.

Wareham, Mass, Sept 2, 1909.

N. A. Coble, Chicago.

Tunnel City, Wisconsin, important shipping point

Wisc. + Minn. Chicago Mil + St Paul will give stations

Mich. Moseley Bros, Grand Rapids, will give shipping points. Carpenter Cook Co, Menominee and Marquette.

or Chicago market Butler, Homan + Co, Chicago, for blueberry market. Also C. T. Love + Co, refer to Mr. Coble

Very large Wisconsin cranberry, Metallic Bell

UNITED STATES DEPARTMENT OF AGRICULTURE,
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TAXONOMIC AND RANGE INVESTIGATIONS.
Washington, D. C.

C. C. Latham, Groton, Mass. Wareham, Mass., Sept. 2, 1909.

Cooking cranberries

Two quarts berries

One quart water, poured over berries

Two and a half ~~Half pint~~ cups of sugar, poured over berries

When they begin to boil

boil ten minutes, hard.

UNITED STATES DEPARTMENT OF AGRICULTURE,

BUREAU OF PLANT INDUSTRY.

TAXONOMIC AND RANGE INVESTIGATIONS.

Washington, D. C.,

UNITED STATES DEPARTMENT OF AGRICULTURE,
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WASHINGTON, D. C.

Concord, Mass., Sept. 3, 1909.

Charles W. Prescott. About 3 acres of open leatherleaf bog, about 50 acres of peat bog, mostly maple bottom.

Budded 5 bushes of _Vaccinium corymbosum_, one bud each.

Area lined with blueberries.

Took three samples of soil from the leatherleaf bog, labeled as follows

Concord 1. From first six inches, brown, filled with dead stems and other remains of leather leaf.

Concord 2. About four inches, nearly black, filled with live fine roots of the leatherleaf, soil rather granular.

Concord 3. Unmeasured depth, nearly black, with many cracks, and few live roots of leather leaf.

Samples sent to Washington.

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Boston, Mass., Sept. 4, 1909.

Bought of a street dealer in fruits a box of fine-looking blueberries for 20¢.

The box contained a leaf of *Vaccinium canadense* and one of *Vaccinium pennsylvanicum*. The berries were, largely, light blue and plump and fairly clean. Out of the box were selected sixteen berries ~~larger~~ more than 12 mm. in diameter. Of these, 12 were 12-13 mm. berries, ~~..~~ and 4 13-14 mm.

A handful of the berries ~~after~~ these 16 had been taken out ran as follows:

7-8 mm	4	berries
8-9 "	24	"
9-10 "	16	"
10-11 "	14	"
11-12 "	3	"

Some of the berries may be *Vaccinium corymbosum*.

Boston, Sept. 4, 1909

UNITED STATES DEPARTMENT OF AGRICULTURE,
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Boston Produce Market Report

Blueberries.

1908	Mass. & N.H.	New Brunswick	Nova Scotia	
July 28 (Tuesday)	9-12		12-14	"Blueberries easier with supplies sufficient for the market wants."
30	7-10		9-11	"Blueberries have been coming more plentifully and the tone of the market is somewhat stuck on same, and prices have materially weakened"
31	7-10		9-11	"Blueberries continue to move slowly with plenty offering at yesterday's quotations and considerable stock too poor in condition to bring even these figures"
Aug. 3 Monday	6-8	6-8	6-10	"Blueberries are in full supply and low with a sticky market prevailing same"
4	6-8	6-8	6-10	Ditto.
6	7-9	8-12	8-12	Receipts of blueberries were heavy during the past week and very low prices ruled. Less stock however offers to-day and the market is doing better".
7	"	"	"	"Blueberries remain as last quoted, with mature stock pretty well runned."
10 (monday)	8-10	9-12	9-12	"Blueberries when fancy bring good prices, but most stock arriving is too poor to be classed as such."
11	"	"	"	"Ditto.
13	"	"	"	"Blueberries hold their own with sufficient receipts to supply all demands".
14	8-10	6-8	8-12	"New Brunswick ~~blueberries~~ arriving mostly poor and bring small prices"
17 (monday)	8-10	6-8	8-12	"Blueberries continue to string out and have a steadily decreasing trade"

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1908 (con)

	Mass. & N.H.	N. Brunswick	Nova Scotia	
Aug. 18	6-7	5-7	6-8	With very heavy receipts for the past few days the blueberry market yesterday and to-day was very weak and prices quoted are practically all that could be obtained.
20	6-8	7-8	8-10	"Blueberries are recovering somewhat from their slump of the first of the week".
21	"	"	"	"Blueberries continue to arrive and sell at quotations".
24 (Monday)	"	"	"	"Blueberries are hard to place and remain as last quoted".
25	6-8	5-7	6-9	"Blueberries in large supply and move slowly at low figures".
27	"	"	"	"Blueberries continue to move at unchanged quotations and offer in good supply".
28	6-8	6-8	8-10	"Blueberries offer in smaller supply and are firmer".
31 (Monday)		6-9	8-11	"The blueberry market is better and firmer returns are being realized.
Sept. 1		"	"	
3		7-9	8-10	"Blueberries shorter and somewhat better returns are being realized for same".
4		"	"	Ditto.
8		7-9	8-11	"Blueberries clean up fairly well with best marks doing a trifle better"
10		"	"	
11		"	"	
14 (Monday)		"	"	"Blueberries continue to work off steadily with some extra fancy marks exceeding prices quoted".

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1908 (con) New Brunswick Nova Scotia

Sept. 15	7-9	8-11	"Blueberries are sticky and hard to ~~place~~ with a wide range in price manifest on same".
17	7-9	8-10	"Blueberries are slow and a long range in prices prevails on same".
18	"	"	"Blueberries slow and easy".
21 (Monday)	7-8	7-12	"Blueberries are in lighter supply and have but a small call".
22	"	"	Ditto
24	"	"	"Only straggling lots of blueberries now offer and these are sold at wide ranges in price".
25	"	"	Ditto
28 (Monday)	"	"	"Blueberries are about done"
29	"	"	Ditto
Oct. 1	"	"	"Blueberries practically done, there being only a few stray lots coming in"
2	"	"	Ditto
5 (Monday)	—	—	"Blueberries done"

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1909 N.C.
June 8 13-22 "Blueberries cleaned up satisfactorily at a wide range in price".
10 10-18 "Stray lots of blueberries arrive and sell at a long range in price according to quality, condition, etc."
11 10-12 "Blueberries sell mostly around prices quoted but now and then an extra mark ranges much higher.
14 (Monday) " "Practically no blueberries offering".
15 " "No blueberries offering to speak of".
18 " "Practically no blueberries have offered for the past few days".
21 (Monday) " "Blueberries offer very scatteringly with practically no arrivals today".
22 " "No blueberries"
24 " "No blueberries to speak of".
25 " "Practically no blueberries ... on the market".
28 (Monday) " "Blueberries scarce and wanted".
29 " "Blueberries in ~~good~~ limited supply and ~~limited~~ good demand".
July 1 N.C. Penn. 15-16 "Blueberries have been arriving quite freely from Penn. for the past day or two and selling well but at gradually declining prices".
2 " "Blueberries move in good shape and keep well maintained in price".
Penn. Mass & N.H.
6 10-14 16-18 "Blueberries move well at good prices"
8 " " "Blueberries meet with a steady sale at well sustained prices".
9 12-14 15-17 "Blueberries have a steady call and work off gradually at well sustained prices"

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1909 (con.) Penn. Mass & N.H.

July 12 (Monday) 12-14 15-17 Blueberries also cleaned up well at practically unchanged quotations".

13 12-14 15-17 "Blueberries sold well in price but many lots showed "sweaty" and clean up slowly".

15 11-13 13-15 "Receipts of blueberries have been liberal this week but demand has been active and the market has held up well, although a lower market is in evidence today".

16 10-12 11-15 "Receipts of blueberries continue liberal with a great deal of slack packing showing up, especially the under layers".

19 (Monday) 10-12 13-15 "Blueberries met with a steady demand and with a light supply offering did a trifle better this morning".

20 10 — 12-14 Blueberries met with a steady demand and with moderate supply offering hold fairly steady".

22 9-10 10-12 Maine 10-12 "Receipts of blueberries have increased materially during the past week, and although there is a steady demand for same the market has gradually eased off in price".

23 " " " Receipts of blueberries lighter and with a steady demand for same the market holds up firm".

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1909 (con.) Penn. Mass. & N.H. Maine

July 26 (Mon.) 10-11 11-14 12-15 "The supply of blueberries was also very moderate and full prices were returned on same".

27 " " " Ditto except "is moderate"

Nova Scotia

29 — -10 10-12 10-12 12-13 "Receipts of blueberries liberal and a much easier market prevails on same".

30 — 10-12 10-12 11-13 Ditto but "and an easy market"

Aug. 2 (Mon.) " " " "Blueberries hold steady and meet with a good sale at general prices quoted".

3 10-12 10-12 11-13 Ditto.

5 " " " "Blueberries continue to find a good market and lots for the most part well cleaned up".

6 " " " Ditto

9 (Mon.) 10-12 10-12 10-12 "A liberal supply of blueberries this morning and stocks, unless extra fancy, moved only indifferently".

New Brunswick

10 10-11 10-11 10-11 9 — Ditto and "N.B. offerings are extremely poor and have to be cleaned up at low figures".

12 9-11 10-11 10-11 8-9 "The blueberry market has gradually eased off during the week and receipts clean up slowly at quotations".

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1909	Mass. & N.H.	Maine	Nova Scotia	New Brunswick	
Aug. 13	9-11	10-11	10-11	8-9	"The blueberry market remains steady with no change to note"
16 (Mond.)	8-10	8-10	8-10	7-9	"Blueberries plenty and selling generally at 8 to 10¢ per quart as to quality and condition."
17	"	"	"	"	Ditto and "with some of the best Nova Scotia at 11¢"
19	8-12	9-12	9-12	8-10	"Blueberries were plenty early in the week at 7 to 10¢, but since the rain Tuesday receipts have been light and prices higher
20	10-12	10-12	10-12	10-12	"Blueberries in light supply today and good berries sell easily at 12¢."
23 (Mon)	"	"	"	10--	"Blueberries hold well but begin to show lateness of season".
24	"	"	10-13	"	Ditto.
26	9-12	9-12	9-13	9--	
27	9-11	9-11	9-11	9--	

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1909	Mass + N.H.	Maine	Nova Scotia	New Brunswick	
Aug. 30	8-10	8-11	8-11	8-10	Blueberries arriving in many cases soft and all such sell at inside figures
Aug. 31	"	"	"	"	Ditto.

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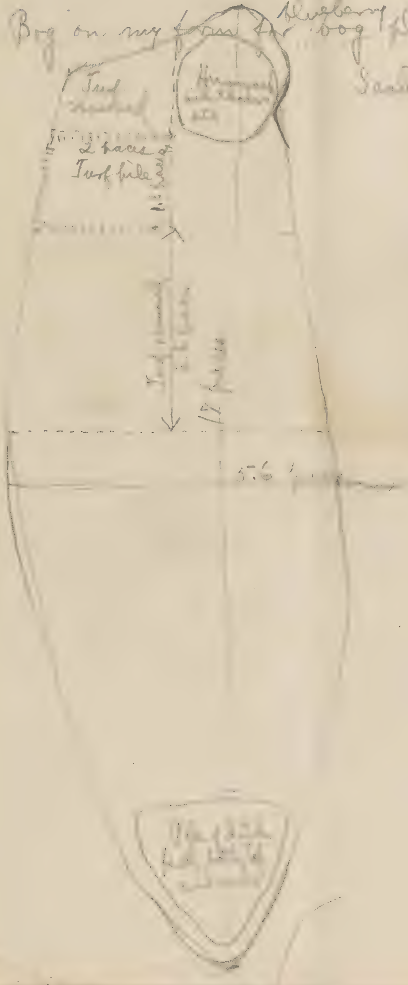
TAXONOMIC INVESTIGATIONS.

Greenfield, N. H. Aug. 8, 1911.

Bog on my farm for blueberry bog planting experiment

Scale 1 cm = 1 pace.



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TAXONOMIC INVESTIGATIONS.

[illegible], N.H., Sept. 9, 1938

Pruning

Sawed all but the budded stem on the big bush north of the swamp. Thirty-nine stems sawed altogether, the largest 3.5 by 2.7 cm. and [illegible] showing about 15 rings. Bud in good condition.

Treated in the same way ~~the budded~~ the bush east of the Cabot bush. Fifteen stems the largest about 2 cm. diameter

~~[illegible]~~ Removed seven stems from the Cabot bush leaving only the budded stem and one other. Bud all right. Largest stem 3.2 by 2.5 cm., [illegible] sawed. Budded stem about 1 cm. in diameter at base, the stem about 15 cm.

[illegible], N.H., Sept. 13, 1938

Picked from the Hadley bush in a bag the [illegible] [illegible], about ½ teacupful, for use [illegible] [illegible] [illegible] about [illegible]

Trimmed the one stem of a bush [illegible] the Cabot bush and cut out a [illegible] [illegible] probably today. Budded bush [illegible] [illegible]

[illegible]
[illegible] 3 [illegible]
[illegible]

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TAXONOMIC INVESTIGATIONS.

Greenfield, N. H., Sept. 9, 1909.

Blueberry meadow. List of 1908 seedlings set in the spring of 1909, in place of 1907 seedlings which were dead or feeble in the spring of 1909.

Row 1 (from east)
Plant 1 (from south) (Culture 44)
2 "
3 (45)
6 "
11 (72)
15 "
16 (72A)
20 (72A)
24 (72A)

Row 2
Plant 7 (45)
10 "
13 "

Row 3
Plant 9 (44)
14 "

Row 4
Plant 2 (44)
6 "
10 "
13 "

Row ~~3~~ 5
Plant 5 (50)
6 "
7 "
8 "
10 (no number)
5 (50)

Row ~~3~~ 6
Plant 1 (50)
3 "
6 "
7 "
10 "
11 "
14 "
16 "

Row ~~3~~ 7
Plant 10 (50)
12
13
16
17
18

Row 8 Plant 18

Row 9
Plant ~~2~~ 6 (50)
10

Row 10
Plant 7 (50)
8 "
18 "
20 "

Fred Mac? [illegible]

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TAXONOMIC INVESTIGATIONS.

Greenfield, N.H. Sept. 9, 1910

Blueberry meadow
Row V (from east)
Plant 1 (from south). Broke back seedling of 1908. Tallest stem 13 cm ~~130 mm~~ ~~130 cm~~; no flowering buds. Culture 44

Plant 2. 1908 seedling, ~~[illegible]~~ ~~15 cm~~ high, no flowering buds. Culture 44

~~Seedling Height of stem Flower buds~~

~~Plant~~ ~~Culture~~	Seedling	Culture	Height cm.	Flowering buds	Remarks
Plant 3	1908	44	15	Apparently	
4	1907		16	None yet	
5	"		12	"	
6	1908	45	22	Apparently	
7	1907		11	None yet	
8	"		14	None	
9	"		11	"	Feeble, few leaves
10	"		16	None yet	
11	1908	72	22	Apparently	One bud alive from [illegible] on a ? cm twig.
12	1907		15	None	
13	"		17	None	Much eaten feeble
14	"		10	"	Longest stem old one; Younger mostly [illegible] of leaves
15	1908	72	24	"	
16	"	72A	25	Apparently	
17	1907		13	None yet	
18	"		11	None	Not very strong
19	"		20	None yet	Old stem longest
20	1908	72A	20	Apparently	
21	1907		17	None yet	Plant large but not vigorous
22	"		23	None	
23	"		15	None	Pink [illegible]
24	1908	72A	17	None yet	
25	1907		22	None yet	
26	"		16	"	

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TAXONOMIC INVESTIGATIONS.

Greenfield, [illegible]

Blueberry meadow (cor.)

Row 2	Seedling of	Cutting	Set out	Height cm.	Flowering buds	Remarks
Plant 1	1907		1908	16	None yet	Two plants, taller measured
2	..		1908	17	..	Two plants apparently, one x. Burned
3	..		1908	12	..	Two plants
4			1908	10+12	Apparently	
5	..		1908	12+10	None yet	
6	..		1908	18	Apparently	Old stem longest
7	1908	45	1909	17	None	
8	1907		1908	12	None yet	
9	..		..	12	None	
10	1908	45	1909	27	Apparently	
11	1907		1908	18	None yet	
12	..		..	14	..	
13	1908	45	1909	19	None	
14	1907		1908	15	None yet	
Row 3						
Plant 1	1908	44	1909	25	None yet	
2	1907		1908	13	None	
3	..		..	10	..	
4	..		..	14	None yet	
5	..		..	11	None	
6	..		..	13	..	
7	..		..	18	None yet	
8	..		..	13	None	
9	..		..	12	None	
10	..		..	11	..	
11	..		..	11	..	
12	..		..	9	..	
13	..		..	20	None yet	
14	1908	44	1909	14	None yet	Old stem longest
15	1907		1908	16	None	
Row 4						
Plant 1	1907		1908	12	None	
2	1908	44	1909	22	None yet	
3	1907		1908	16+17	..	Two plants
4	..		..	13	None	
5	..		..	12+10	..	
6	1908	44	1909	21	None yet	

Greenfield, N.H., Sept. 3, 1909

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TAXONOMIC INVESTIGATIONS.

(Blueberry meadow (con.)

	Seedling	Culture	Set out	Height cm.	Flowering buds	Remarks
Row 4 (con.)						
Plant 7	1907		1908	12	None	Apparently, two plants, one removed
8	"		"	12	"	
9	"		"	16	"	
10	1908	49	1909	20	None yet	
11	1907		1908	12	None	
12	"		"	22	None yet	
13	1908	49	1909	16	" "	
14	1907		1908	12	None	
15	"		"	17	Apparently	
16	"		"	16	None	
Row 5						
Plant 1	1907		1908	18	None	
2	"		"	12	"	
3	"		"	13	"	
4				17	None	Plants apparently 3, 2 south [illegible] removed
5	1908	50	1909	22	None yet	
6	"	"	"	25	" "	
7				26	Apparently	Shoot [illegible] still growing
8	"			30	None yet	
9	1907		1908	10	None yet	Two plants, south one removed
10	1908		1909	19	None	
11	1907		1908	8 + 14	None yet	Two plants
12	"		"	13	None	
13	"		"	10	"	
14	"		"	14	None yet	
15	1908	50	1909	17	None	
16	1907		1908	19	None	
Row 6						
Plant 1	1908	50	1909	18	None	
2	1907		1908	16	None	
3	1908	50	1909	30	None yet	
4	1907		1908	14	None	
5	"			19	None	
6	1908	50	1909	20	None yet	Shoots still growing
7	1907		1908	20	Apparently	
8	"		"	15	Apparently	One well formed flowering bud
9	1908	50	1909	30	None yet	New growth 16.5 cm.

Greenfield, N. H., Sept. 9, 1909 (4

Blueberry meadow (con)

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WASHINGTON, D. C.
TAXONOMIC INVESTIGATIONS.

Row 6 (con.)	Seedling	Culture	Set out	Height cm.	Flowered fruited	Remarks
Plant 10	1908	50	1909	19	None.	Longest stem branched above.
11	"	"	"	18	"	Old stem longest.
12	1907		1908	16	None	
13	"		"	17	"	Two plants, northernmost removed
14	1908	50	1909	26	None	
15	1907		1908	24	Apparently	
16	1908	50	1909	18	None	Old stem longest
17	1907		1908	17	None	
Row 7						
Plant 1	1907		1908	23	None yet	
2	"		"	16	"	
3	"		"	18	"	Two berries just dropped off [without ripening]
4	"		"	22	"	
5	"		"	16	"	
6	"		"	16	"	
7	"		"	8 + 12	None	Two plants.
8	"		"	10	Apparently.	Bushy and half grown
9	"		"	16	Apparently	
10	1908	50	1909	28	None yet	Longest new growth 21 in.
11	1907		1908	11	None	
12	1908	50	1909	16	None	
13	"	"	"	19	None yet	
14	1907		1908	11	None	
15	"		"	17	None yet	
16	1908	50	1909	17	"	
17	"	"	"	"	None	
18	"	"	"	23	"	
Row 8						
Plant 1	1907		1908	14	None	
2	"		"	29	None yet	Leaves nearly all reddened
3	"		"	20	"	
4	"		"	21	None	
5	"		"	15	"	
6	"		"	24	Apparently	
7	"		"	22	None yet	
8	"		"	21	None	
9	"		"	23	Apparently	
10	"		"	24	None yet	

Greenfield, N. H., Sept 7, 191[illegible]

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WASHINGTON, D. C.

TAXONOMIC INVESTIGATIONS.

Blueberry mesglow(?)

	Seedling [illegible]		Set out	Height in.	Flowering buds	Remarks
Row 8 (Con.)						
Plant 11	1907		1908	17	None yet	
12	"		"	18	None	
13	"		"	21	None	
14	"		"	17	None	
15	"		"	11	"	
16	"		"	15	"	
17	"		"	23	" None yet	
18	1908	50	1909	15		
Row 9						
Plant 1	1907		1908	22	None yet	
2	"		"	16	"	
3	"		"	16	Apparently	
4	"		"	13	None	
5	"		"	20	"	
6	1908	50	1909	27	Apparently	
7	1907		1908	20	None	
8	"		"	17	Apparently	
9	"		"	21	None	
10	1908	50	1909	31	None yet	
11	1907		1908	23	None yet	
12	1908	50	1909	17	None	
13	1907		1908	15	"	
14	1908	50	1909	18	None.	Old stem longest
15	1907		1908	17	None yet	
16	"		"	17	None	
17	"		"	25	None	
18	1908	50	1909	16	None	
19	1907		1908	20	None	
Row 10						
Plant 1	1907		1908	15	None yet	
2	"		"	16	None	
3	"		"	13	"	Plant feeble
4	"		"	12	"	" "
5	"		"	17	"	
6	(Pine b[illegible] ———)					
7	1908	50	1909	20	None yet	
8	"	"	"	22	None	All old wood but large(?), green, moist and shady situation

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WASHINGTON, D. C.

Blueberry meadow (con.)

TAXONOMIC INVESTIGATIONS.

Row 10 (con.) Plant 9	1907		1908	24	None yet	
				21	apparently	
10	"		"	17	"	
11	"		"	22	None	
12	"		"	15	"	Much eaten by [insects
13	"		"	19	"	
14	"		"	"	"	
15	"		"	25	None yet	
16	"		"	20	None	Much eaten by insects
17	"		1909	18	None yet	
18	1908	30	1908	22	None yet	
19	1907		1908	20	None	Tallest stem denuded [above
20	1908	30	1908			

UNITED STATES DEPARTMENT OF AGRICULTURE,
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WASHINGTON, D. C.

En route from Greenfield Sept. 10, 1909

Is not the iron the deleterious substance in the clay loam about Washington. Discuss with some chemist the chemistry of bog iron, and also make cultures of seedlings in peat and in peat-fed sand each charged with iron. Does the iron act by tying up all the phosphoric acid

Sept. 14, 1909.

Budded by Mr. Boyle on Sept. 23, 1909, with Brooks bush buds sent on twenty-six plants, as follows: three on 1908 seedlings, the others on 1907 seedlings.

" 65, 1 plant

" 89A 2 ~~plants~~.

Culture 133. One of the cuttings potted July 12, 1909, has died. The ~~pot~~ was discarded.

Culture 118. Tall plant, probably tallest, measures 693 mm.

Culture . Twenty cuttings from the Brooks bush placed by Mr. Gages under a bell glass in new ordinary buff-colored propagating sand in the propagating house today. These cuttings were made by me at Plainfield Sept. 11, 1909.

Culture . Twenty-five cuttings [the same as last entry]

The slat ~~coverings~~ which all through the summer, on sunny days, were kept over the out door plants from 9:00 A.M. to 4:00 P.M., and which beginning about August 25 were used from 10:00 to 3:00, began on yesterday to be left off altogether. The plants are now laying down flowering buds, though many have not yet begun to do so, their growth still continuing.

Sept 17/01

[illegible] [illegible] [illegible] still remaining [illegible]
[illegible] [illegible] [illegible] [illegible] [illegible]
and [illegible] [illegible] [illegible].

Sept 15, 1909.

Culture 157 β. A stocky bud cutting taken off of 157 and potted by Mr Geddes about Sept. 6, 1909. The ultimate bud on the cutting has developed into a flowering bud, although when the cutting was made no such differentiation had begun to manifest itself.

Culture 157 A. The (two upper) buds have developed into flowering buds since the cutting was made.

Sept. 18, 1907.

Culture 192. Took the cuttings out to-day for potting. One was dead, all the others rooted and ~~all~~ branches started. The roots reached a maximum length of 6 cm, the new branches 20 cm. Seven were potted in 4-inch pots, eight ~~six~~ in 3-inch pots. Nine others taken out in culture 192A. Kalmia peat 8, glass sand 1.

Culture 192A. Nine ~~Eight~~ plants from Culture 192 potted in 3-inch pots, kalmia peat 8, glass sand 2.

Culture 154. Only one cutting still with leaves, this moved to Mr. Sage's house. Large callus but no roots yet.

Culture 194. Forty-five cuttings from the Brooks bush, put in propagating house by Mr. Sage, under bell-glass, buff sand, Sept. 13, 1907. In many of these cuttings the uppermost bud is a flower and in the others the uppermost bud is a flowering bud.

Culture 193. Seeds have begun to germinate

Sept. 16, 1909.

Culture 115. A flat prepared by Mr. Fogle with fine-sifted peat 4 parts, pots sand 1 part, overlying a peat fiber bottom, sowed to day with seed from the Stanley bush, Greenfield, N. H.

B P I

Sept. 20, 1909

Cuttings 187. Bud dead, had been healed on in part
188 " " , never healed on
189 " " " "
181 ~~Bud~~ living
182 " "
189A " "
190 " "
191 One bud dead, one alive,
184 Bud living
189B " "

The plants in 4-inch and 3-inch pots are not so dark green and heatlthy as those in 6-inch pots

Epigaea repens, Seeds still germinating.

Cutting 196. This number is given to the cuttings of Vaccinium pennsylvanicum from the large berried patch on Mr. Frank Russell's farm at Greenfield N.H. They were put in the ~~[illegible]~~ outside propagating frame August 31, 1909 and bud growth has started on nearly all the. In one the new growth axis is 3 cm long. Two ~~[illegible]~~ taken up and put back in the soil again, show no new rootlets.

Cutting 197 Some root cuttings taken from the ~~[illegible]~~ same plants as Cutting 196 ~~[illegible] cuttings of the~~ were placed in the outside propagating frame August 31, 1909. No shoots have appeared above ground. One cutting dug up showed both new shoot growth and new roots

Sept. 20 1909

Cutters 179. Only one cutting still bears a leaf, and three others ~~are~~ still bear green stems. Others browned, without callus, and removed.

Cutters 177. Cuttings all alive and growing, one with new wood 11 cm long.

Cutter 173. ~~Stand~~ Cuttings apparently all starting

Cutters 178. Twenty eight cuttings appearing superficially to be in good shape, but several dug up show no roots, nor any callus. Slight growth has taken place in some.

Cutters 171. Cuttings all well started

Cutters 172. Cuttings all dead and removed except three, these leafless, callused but not rooted.

Cutters 169. Cuttings all dead

170 " " "

166 " " "

Cutters 167. Nine cuttings alive, leafless. Those dug up were well callused, but with no roots.

Cutters 168. Fourteen cuttings still alive showing leaflets. Several dug up were all dying from the base, mostly with never any callus.

Sept. 20, 1909

Cutting 158. Five cuttings all still with leaves, part with callus, part without, none dead at the base, none with roots.

Cutting 156. Last cuttings dead

Cutting 150. Last cuttings dead some time ago.

Cutting 194. Five leaves yellowed or brown, removed.

Sept. 22, 1909

Culture 198. This number is given to an eight-inch saucer sowed with seeds of Vaccinium pallidum Aug. 27, 1909, by Mr Gouger in a mixture of sand, peat, and sphagnum similar to that of 192. The first seeds were germinated today.

Culture 199. This number is given to a seven-inch saucer sowed with seeds of Polycodium melanocarpum Aug. 27, 1909, by Mr Gouger in a mixture of sand, peat, and sphagnum similar to that of 193. No seeds germinated as yet.

Culture 200. This number is given to the Epigaea repens sowed in July, 1909, from Greenfield. On some of the seedlings the second leaf is as large as the cotyledons.

Sept 24 1909

Cutting 114. Initiating of the few yellowish (wounded) leaves two of the cuttings have been [illegible] of leaves

Sept. 29/1909.

Mr. Oliver says that Mr. Grieve, Redbraes Nursery, Edinburgh, has raised <u>Rhododendron</u> seedlings by the thousand, and ~~he~~ is an expert in this business

Culture 178. Some of the Dendromm cuttings are beginning to callus.

Sept. 30, 1909.

Culture 201. Rhododendron maximum. Eighty-five plants taken from Culture 161, and transplanted into a flat at about two inches distance from each other. The seedlings have one to three leaves besides the cotyledons, the largest leaves having a length of about 1 cm. Soil 9 parts kalmia peat sifted through a quarter-inch sieve, 1 part glass sand, underlain by a drainage mass of kalmia peat fiber. Transplanting by Larry Boyle. Placed in outside propagating frame.

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WASHINGTON, D. C.

Sept. 30, 1909.

Etherizing. ask Oliver about process, published a few years ago in Florists Exchange, ~~last~~ (1 cc. per cubic foot of air, for 48 hours)

[illegible] Gay. [illegible] Lanham Md. Oct. 1, 1908

Kalmia latifolia. Flowering bud clusters for next year now being laid down. On some branches of some plants the bud from which the flowering cluster is to develop is just emerging from the leaf axis. In most cases they are farther developed, reaching a maximum length of 6 mm, with branches, but the bracts still appressed and the flower buds themselves not exposed.

Vaccinium [illegible]. Shoots on a bush cut back winter, most of Scofield's orchard, after 110 mm. (? 3 inches) high, the side branches some 33 mm long with a considerable number of flowering buds (as many as 11 on a 16 mm branch). The lower of these flowering buds are still growing.

Vaccinium [illegible]. The two branches on which an experiment in the development of flowering buds from leaf buds was started on August 29 now have flowering buds as follows:

Branch with current twigs

First twig (from base)	5 flowering buds,	[illegible]
Second	3	9
Third	3	11

BPI

Fourth	3	[illegible]
Fifth	3	[illegible] 10 [illegible]
Sixth	4	10
Seventh	5	11
Eighth	~~15~~	
Ninth	6	13
Tenth	5	4
Eleventh	4	5 [illegible]
Twelfth	5	14
Thirteenth	4	8
Fourteenth	3	11
	[illegible]	110

Branch with cut leaves

First twig (from base	2	Leaving leaves 2 [illegible]
Second	1	4
Third	3	7
Fourth (Nagging [illegible]	0	3
Fifth	1	4
Sixth	3	6
Seventh	2	3
Eighth	2	6
Ninth	2	5
Tenth	1	9
Eleventh	2	3
Twelfth	2	6
Thirteenth	3	11
Fourteenth	1	4
Fifteenth	3	13
Sixteenth	2	12
	31	102

On the "Bush 2" the experiment of August 24, 1901, the up-

permost buds of the cut branches were transformed into flowering buds even when the cut was made some distance below the lowest of the buds that would have developed into flowering buds.

Oct. 2, 1909.

Culture 158, Remaining 5 cuttings still in leaf but thrown away. One callused, others withering, no roots.

Culture 168. Cuttings all removed, 14. None callused, mostly blackened from base to surface of sand.

Culture 167. Cuttings all taken up, seven in good callus but leafless put back to see if they will root.

Culture 174. For several days the leaves of these cuttings have been turning to a ~~shedded~~ yellow ~~and~~ red, brown and purple like Crotons, and dropping off rather freely. Twelve have no leaves at all

Oct. 2, 1909.

Culture 202. Gaylussacia dumosa. Rootstock-stem cuttings, , from Lanham, Md., Oct. 1, ~~from~~ along the roadside west of Scofield's pine woods. Propagating frame, glass sand.

Culture 202 A Gaylussacia dumosa. Rootstock cuttings, , from [etc as above]

Culture 203. Polycodium, Rootstock-stem cuttings, from Lanham, Md. Oct. 1. Trail bush, from the pine woods on the trail from Scofield's to Brown's. Propagating frame, glass sand.

Culture 203A. Polycodium, rootstock cuttings, Eight in first row [illegible], eight in second row and four in third row not [illegible]. From Lanham [etc as in 203]

Culture 204. Leucothoe racemosa, rootstock-stem cuttings, 4 Lanham, Md. Oct. 1, south edge of the Collins-Scofield woods. Propagating frame, glass sand

Culture 204 A Leucothoe racemosa, rootstocks. Eight cuttings from [illegible] in first row, four [illegible] in second row. From Lanham [etc as in 204]

Culture 205. Pieris mariana, ~~[illegible]~~ rootstock-stem, 26 cuttings, from thicket west of Scofield's orchard, Lanham, Oct. 1. Propagating frame, glass sand.

~~Culture 206. Pieris mariana, rootstocks.~~

Culture 205 A Pieris mariana, rootstock, 12 cuttings, from thicket [etc as in 205]

Oct 2, 1909

Culture 206 Vaccinium atrococcum, ~~Swingle bush~~ roots, 10 cuttings. Swingle bush, in the pine woods, Scofield - Brown trail, Lanham, Md., Oct. 1, 1909. Propagating bed, glass sand.

Culture 207 Vaccinium atrococcum, ~~Swingle bush~~ 20 twig cuttings. Swingle bush [do as in 206]

Culture 208 ~~Swingle~~ Vaccinium atrococcum Swingle bush, 13 twig cuttings and 22 rooted cuttings (same as #206 + 207) all put in Sec. Gage house in yellow sand without cover.

Cuttings 150. Remaining cuttings, [illegible] 4/1907 eight in number, removed from the board to day. All dead, except two, with no shoot. Three had been calloused, two of these had the callus still barely alive.

Cuttings 154. Remaining cutting shed one leaf to day, other leaf greenish yellow, red and brown.

Cuttings 194. Twenty-three cuttings out of 45 have now lost all their leaves. The wood and buds look very well indeed.

Seedlings of 1908 ~~[illegible]~~ Flowering buds still in process of formation.

Cuttings 192. All the cuttings are growing except one in a 3-inch pot, that one wilted.

Cuttings 192A Eight plants wilted and are thrown out, leaving one now growing.

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF PLANT INDUSTRY,
WASHINGTON, D. C.

Oct. 5, 1909.

Pruning experiment for the summer of 1910.

Immediately After a wild plant of Vaccinium has laid down its flowering buds for the succeeding year, cut off some, say half, of the ~~stems~~ and see if the remaining stems ~~buds~~ will not proceed to lay down new flowering buds additional to those already laid down.

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF PLANT INDUSTRY,
WASHINGTON, D. C.

Oct. 5, 1909

The pruning experiments recorded under the dates August 24 and October 1, 1909, show (1) that if, immediately after the flowering buds for the succeeding year are formed, that portion of a twig bearing these buds is cut off one or more of the leaf buds below the cut proceed to transform themselves into flowering buds and (2) that (over). These results would indicate that in blueberry culture a moderate superficial pruning of the twigs may safely be ~~given~~ made during the period after the fruit is gathered and before the flowering buds for the succeeding year are developed, without necessitating the loss of a fruit crop in the succeeding year. If such a pruning were ~~made~~ given at the end of the growing season, or during the winter, or in early spring the flowering buds cut off would not be replaced by others and all their fruit would be lost. If a superficial pruning ~~should~~ proves to be an advantageous method of stimulating crop production the best season for the pruning seems to be just after fruiting, unless it turns out

when a little earlier, just before the flowering buds are developed, the ends of twigs are cut off the uppermost buds of the cut twig develop into flower buds.

that the [illegible] of a part of the foliage in late summer impairs, ultimately, the vitality of the plant

Oct. 5, 1909

Of the twenty-six plants with budded with buds of the Brooks budded by Harry Boyle on Sept. 2 and 3, four plants with sound buds were brought into a greenhouse, without [illegible] to hay, and cut back so as to force the buds to grow if possible. These plants are in five-inch pots and of the following Cultures, 11, 17, 21, 70. To be repotted in 7-inch pots soon.

Culture 182 from outdoors brought into the [illegible] greenhouse and cut back to force the bud if possible. To be repotted in 9-inch pot.

Culture no. [illegible]. Plants in greenhouse cut back to force buds if possible. To be repotted in 7-inch pots.

Culture 197. Five of the cuttings have made shoots that have reached the surface of the sand.

Culture [illegible]4. Twenty cuttings now [illegible] of leaves.

~~Sept~~ Oct. 6, 1909.

Pruning experiment. A plant of Culture 56 is pruned by removing 9 basal stems of various sizes, the largest stem being left. This is about 46 cm. high with 56 leaves. In axils 1 to 7, and 9, from the top flowering buds have developed. The experiment is designed to ascertain whether additional flower buds will be laid down. This plant was still making new growth on some of the stems that were cut off.

Pruning experiment. A plant of Culture 47 is pruned by removing 7 basal stems, the largest two being left. The taller is about 51 cm. high. It has laid down a flowering bud in the uppermost axil. On the other stem have been laid down 5 flowering buds, two on the main axis, one on the upper branch, two on the lower branch, all in the upper axils. Will additional buds be laid down. None of the stems removed was making new growth.

Pruning experiment. 43 (5) is pruned by removing 7 branches stems of various sizes, the best (but not largest) one being left. This is about 43 cm. high and has a flowering bud in the uppermost axil. Growth on the cut branches had ceased. Will new flowering buds be laid down,

Oct. 6 1909

Culture 194. Thirty-three seedlings have now lost all their leaves.

Culture 209. Twenty-eight plants of Epigaea repens taken out of Culture 200 and planted in an eight-inch saucer with peat 1, glass sand 1. The plants have one or two leaves besides the cotyledons and reach a height of only about 3 mm.

Oct. 8, 1909

Culture 171. Polycodium — Six rooted
cuttings potted yesterday in 3 inch
pots in kalmia peat & glass sand 1.
Left in propagating frame.

Culture 173. Polycodium — Four rooted
cuttings [etc as under 171]

Culture 174 Polycodium — Six rooted
cuttings [etc as under 171]

Culture 197 *Vaccinium pennsylvanicum*.
Seven sprouts now visible above the
sand.

Culture 196 *Vaccinium pennsylvanicum*
about 15 cuttings have made new
growth 3 to 5 cm long, about 5
have made none. Some of the
advanced cuttings taken up yesterday
showed no roots and were put
back

Smithsonian [illegible]. Growing buds now abundant
[illegible] on the [illegible], usually
[illegible]. [illegible] in [illegible]
[illegible]. Many [illegible] on [illegible] not yet fully [illegible]
[illegible] beginning to [illegible]

Oct. 7, 1909

Culture 210 Azalea lutea. Eighty five seedlings taken out of Culture 163 and set out in a flat, 2 inches apart, in kalmia peat 9, glass sand 1, on October 5th 1909 by Miss Brown. The seedlings have mostly 5 to 6 leaves besides the cotyledons, the largest leaves being about 1.5 cm long. Branches are already starting in some from the lowest axils. The leaves are revolute before expanding. Placed in [illegible] house, shaded.

Culture 167 Thirty plants of Leucothoe racemosa, set out in a flat, at 2 inch intervals each way, in kalmia peat 9, glass sand 1, October 7. This took all the seedlings thus far developed in Culture 167. They are of various sizes from no leaves except the cotyledons to seven leaves. Tallest plant 3.5 cm high, longest leaves 1.5 cm long.

Placed in covered cold frame Oct. 8 1909 to-day—[illegible]

~~To go in greenhouse~~ not germinating ready yet,

Culture 64 12 plants 7 in pots, to be plunged in sand

" 64 A

Culture 134 (Kalmia), 12 plants 4 in pots " " "

" 134 A " " " " "

Culture 132 (Ledum) 3 plants

Culture 43 & 2 (Ledum) C. 1 (formed)

Culture 55, formed plant

Culture 47

Culture 45 Rhododendron. 6 plants.

Culture 197 Dendrium 1 plant

196 " "

October 7/09

Culture 194. Thirty very cuttings with no leaves, nine with leaves, one each.

Culture [illegible]. Remaining 4 cuttings taken up from the propagating house bed (glass and today). Three leafless were dead at the base though one callused. The fourth with a good green leaf had a big callus slightly rusty, but no roots. This was potted in kalmia peat & glass sand 2., thumb pot. Left in propagating house

Culture 157. The single cutting, the only one left except 157A and 157B, with a good green leaf and a large slightly rusty callus but no roots. Potted in a thumb pot in kalmia peat & glass sand, and left in propagating house.

IX. 8/'07.

Item 211 Leucothoe catesbaei. Eighty fine plants [illegible] from [illegible], 11½, and set out October at 2 inch intervals in a flat in [illegible] [illegible] [illegible]. [illegible] placed in [illegible] house. [illegible] all in [illegible]

Plants with [illegible] [illegible] [illegible] the cotyledons, largest about 1.5 cm high, largest leaves 7 mm long.

[illegible] [illegible] [illegible] (main stem 6 cm high) has laid down flower buds as follows:

Largest stem		
Main axis		6 flowering buds
Uppermost branch		4
Next	"	3
Next	"	1
Next	"	4
		3
Next	"	4
Next	"	2
Another stem		2
"	"	5
"	"	3
"	"	3
"	"	2
		42

Cf. Item 2002, [illegible] [illegible] carefully [illegible]

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF PLANT INDUSTRY,
WASHINGTON, D. C. Oct. 12, [illegible]

The out door plants have made distinct progress in the laying down of flowering buds since October 9, that is the buds in process of swelling are distinctly larger.

Many of the plants in 3-inch and 4 inch pots have reddened their foliage, and the leaves in several now [illegible]

On plants still vigorously growing when the cool weather comes the coloration is dark purple; on injured leaves and poorly nourished plants ~~a lighter red~~, and on the lower parts of the stem as coloration proceeds, a bright red. In a few cases leaves formerly injured ~~by~~ the careless mowing of the shoots so that their midrib was broken are bright scarlet on a stem with otherwise purple leaves.

[illegible] 183. Tying removed from [illegible], in good condition

191 Tying removed, [illegible] beneath it but still [illegible]

1818 Tying removed, but wood alive but feeble.

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF PLANT INDUSTRY,
WASHINGTON, D. C.

Oct. 12, 1909

Of the buds from the Brooks bush put into 1907 and 1908(3) seedlings on Sept 2 & 3 by Mr. Boyle, 13 were taken out dead to-day. These were all outdoor plants. All those of the 1908 seedlings had lost their buds. In nearly every case the ~~entire surface~~ wood of the stock had callused over the entire inner surface of the wood and bark of the bud. The union had been made with the bud in these cases notwithstanding the fact that in some the pith in the bud wood was still somewhat green, and in one or two a bit of the bark was still green. The bud wood although fed with moisture from the stock appears to be exceedingly sluggish in the matter of union. This leaves outdoors only four living buds of this lot, all budded Sept 2, 1909.

Of the 1907 seedlings budded on Aug. 13, 1909, with pallidum buds, seven outdoors are still alive, 181, 183, 184, 189 A, 189 B, 190, 191, but none were assured of success

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF PLANT INDUSTRY,
WASHINGTON, D. C.

Oct. 12, 1908

Culture 130, The two out-door plants, potted June 15 '08, are laying down flowering buds

Culture 122. On the larger graft two additional large buds, apparently flowering buds have been laid down in the last two weeks as follows; one the fourth bud from the summit of the shorter fork of the main branch, making four flowering buds on this fork, the other in the seventh axil below the fork of the main branch

Culture 199. One leaf each on two cuttings removed, others leafless. One cutting removed, the rest browned and dead though callused below. On those cuttings with a cut summit, the uppermost bud is swelling, but abnormally because of differentiation into a flowering bud, not in preparation for branch production

Culture 208. Four cuttings have lost their leaves.

Culture 207. One cutting removed for a herbarium specimen a few days ago. One lost its leaves a few days ago, [illegible] the cutting slightly [illegible] placed.

Oct. 12 '09

Culture 203 A. A root cutting taken up to-day had begun to callus along the cambium at both ends.

Culture 202 A. Two root cuttings taken up to-day showed no signs of callus at either end.

Culture 202. A rootstock-stem cutting taken up to-day showed no sign of callus on the cut surfaces, but a bud on the ~~[illegible]~~ underground part of the rootstock was pushing.

Culture 203. A rootstock stem cutting taken up to-day show the beginning of callusing along the cambium, and a bud on the part above ground is swelling.

Culture 204 A. Two cuttings taken up to-day. On one end of one, the second being the south, callusing is apparently just beginning.

Culture 204. One rootstock stem cutting examined to-day. Callusing has begun.

Culture 205 A. One cutting examined. Callusing has begun on one end.

Culture 205. Cutting examined. Callusing begun.

Culture 196. One half [illegible] cutting removed. The ~~three~~ growing cuttings taken up. Two rooted, [illegible]

Oct 12 '09

Culture 201. One plant damped off, removed. Several show new leaf growth.

Smithsonian bushes. Note the peculiar appearance of the flowering buds, ~~which~~ look as if they were swelling preparatory to growing. They are simply expanding and fattening in the process of forming their flower buds inside. The newly enlarged inner scales are yellowish green, not yet browned or even purpled.

3 ~~94~~

UNITED STATES DEPARTMENT OF AGRICULTURE,

BUREAU OF PLANT INDUSTRY,

WASHINGTON, D. C. Oct. 13, 1908.

Cuttings 209. One plant found broken or girdled at the surface of the ground. Shade removed.

Cuttings 210. Plants all alive and ~~[illegible]~~ growth apparently begun. Shade removed.

Cuttings 211. Plants all alive and in good shape.

Vaccinium ovatum (Seringes, P.I.N. 269) Twenty-eight plants in 3-inch pots. Sowed Oct. 5, 1905, by Harry Boyle in a sphagnum-sand mixture (everything dies) ~~and potted off last~~ ~~in a flat and~~ [illegible] spring or summer [illegible] moved to-day in the ~~[illegible]~~ plunging little greenhouse. All are growing and are 3 to 10 cm. high.

Culture 205. Five cuttings have lost their leaves. Two not [illegible] [illegible] of ~~[illegible]~~ [illegible] either had callused.

Culture 154. Remaining leaf lost.

Culture 194. Only one cutting with a bud, but a good one.

Culture 212. Twelve plants of Culture 128 repotted by [illegible] [illegible] Oct. 9 in 5-inch pots, [illegible] [illegible] [illegible] equal, all [illegible]. Placed in [illegible] [illegible] house.

Culture 176, [illegible]. ~~[illegible]~~ The plant placed in the covered frame [illegible] days ago [illegible] begun to grow [illegible] [illegible] [illegible].

Culture 213. A 1907 seedling, of Culture [illegible] ~~[illegible]~~ with a [illegible] [illegible] [illegible] [illegible] [illegible], now the [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]. [illegible] [illegible] [illegible] [illegible] [illegible] about a [illegible] [illegible] [illegible]. [illegible] [illegible] [illegible] [illegible] [illegible].

Culture 209. A second plant [illegible] [illegible] [illegible] [illegible]. Eleven plants [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] plants

[illegible] ~~[illegible]~~ afternoon [illegible] [illegible]
[illegible], [illegible] [illegible], ~~[illegible]~~ [illegible] [illegible]
Ten planes [illegible] a good color but [illegible] [illegible]
[illegible] new ~~[illegible]~~ [illegible] ~~[illegible]~~
[illegible] [illegible] [illegible] [illegible] [illegible]

Oct. 14, 1909

Culture 193, A showing of additional germina-
tion is taking place. The older seedlings
show one and two leaves but neither
equal in size to the cotyledons. These
reach a length of 4 mm. when fully ex-
panded, 1.5 to 2 mm. ~~germination~~ when
first expanded,

Culture 194. None germinated yet.

Culture 195. Germination continuing

Culture 160. Germinating sparingly

Culture 159. Four Gypsum seeds that
happen to lie on the surface are
germinating. Their long hypocotyls have
split like peach pits and their radicles
have penetrated the ground.

Culture 195 Extensive germination is under
way, though no cotyledons are as
yet expanded,

Culture 196. One head cutting removed. Four
or six others taken up and examined, all
callused. Twenty [illegible] cuttings [illegible] the first
Culture 197 being the new [illegible] united
The cuttings [illegible] had a good callus
of both [illegible] had no new roots [illegible]
removed.

Oct. 17, 1918.

Cutting 103, a plant of this cutting has reached about 150 flowering buds.

Cutting 176, with one plant, branches have begun on nearly all the twigs. No roots yet at the pot (6-inch)

Cutting 177 cut down. No long growth yet. Good root growth on one side of the pot.

Cutting 176, growth rather [illegible], [illegible] at the wall of the pot.

Cutting 177, [illegible] [illegible] [illegible] [illegible] at the wall of the pot.

Cutting 214. Six plants removed of the 12 of 1-2 [illegible] a few days ago

Cutting 215. [illegible] plants of the 12 of 1-2 potted a few days ago, transferred to-day to a single stock [illegible] [illegible] long.

Oct. 15, 1909.

Culture 207. One plant eaten off by an insect.

Culture 208. Six of the twig cuttings have now lost their leaves.

Culture 296. A plant of Culture ~~[illegible]~~ 71, budded by Harry Boyle Sept. 2, 1909, with a Brooks beach bud. The bud now in good condition. All stems except the budded stem cut off. Pot (5-inch) placed in the propagating frame to-day to see whether the moist atmosphere will keep the bud alive.

Oct. 16, '01.

Culture 155. Moved to house no. 1. The low temperature and feeble light in the propagating frame seem to offer little stimulation to growth. Many of the germinated seeds appear not to have been planted deeply enough, [illegible] the seed lies on the surface as the ~~seed~~ plantlet grows to some length before it is able to get its root firmly into the soil. The hypocotyl axis tends to lay out.

Culture 159. Moved into house no. 1 and covered except the sides, with glass

Culture 160 [Same as 159]

Culture 193 [Same as 159]

Culture 198 [Same as 159]

October 19, 1927.

Culture 205. Ten of the twig cuttings have lost their leaves. Two cuttings discarded neither callused, one dead, the other partly so.

Culture 194. Seven of the cuttings cut at the top now show a green swelling of the uppermost leaf bud, which is now developing into a flowering bud.

Culture 211. Four plants were found cut off beneath the soil surface on Oct. 16.

Culture 164. Two plants are now gone.

Culture 195. Cotyledons in many seeds expanded.

Culture 157. Pericarp halves removed from two seedlings. The cotyledons remain enclosed in a tightly fitting membranous sack.

October 29, 1909.

Culture 200. Epigaea. Second foliage leaf in several plants now as large as the cotyledons. Some plants becoming purplish [illegible]

Culture 199. One seed germinating. Is it a Polycodium. Sinter taken into the greenhouse.

Culture 159. Stem bow of ~~[illegible]~~ a fifth seed out of the ground to-day. The two seedlings aided by carefully removing the pericarp a few days ago have made no progress. The one with pericarp imbedded in the ground has now withdrawn its cotyledons but they are not yet expanding. The remaining ~~[illegible]~~ seedling has lifted the pericarp free of the ground.

Culture 193. First foliage leaf in some as large as the cotyledons.

Culture 195. Germination and cotyledon expansion going on freely.

Heavy frost last night. No considerable ~~[illegible]~~ change is noticeable in the outdoor plants, except that the dark purple coloration of leaves is more general. Almost every plant shows some purpling, many are purpled throughout.

October 20 19[illegible]

Budded plants in the greenhouse 7-in box. Plants no 70, 21, 182, and 186 are pushing buds on their cut-back stems. Those numbered 11 & 185 have not started. No 11 was not cut back.

October 2, 1907.

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Culture 211. Seven plants now gone, but pulled by the worms, part cut off apparently by sow bugs. Plants slightly purpled

Culture 201. One plant gone

Culture 204. Nine plants alive in outer ring, eight in next, five in middle. The purplish plants are decidedly purple or purplish on the backs of the leaves and the cotyledons. A plant found cut off had two wire worms in the soil near it

Culture 43 I_3 This plant (annuum type) has 38 flowering buds laid down, and some more, apparently in process of formation

Culture 55. ~~One~~ small leaved many-stemmed plant ~~which~~ has 30 flowering buds.

In all the outdoor plants, that have purpled foliage, leaves or parts of leaves protected by shading from the light remain green for a longer time.

Culture 56A. One of the small leaved many-branched plants has laid down 57 flowering buds.

Ovr. The plants in our seedlings which show the most precocious development of flowering habit are not the ~~large~~ most robust and few-stemmed fellows with large leaves [illegible] with back and often [illegible] at one year of age, but the many-stemmed smaller plants with smaller narrower, highly serrate leaves [illegible] (amoenum type). The same is true of the seedlings of 1907 and of plants brought [illegible] by the [illegible].

Can these narrow leaved plants be hybrids of corymbosum and Pennsylvanicum?

October 22, 1909.

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Culture 207. Five cuttings have lost their leaves.

Culture 167. Two cuttings taken up. On one the callus and an adjacent centimeter of stem was dead; cutting removed. The other not rooted; replaced.

Culture 159. One of the seedlings from which the primary was removed is still ~~[illegible]~~ ~~alive~~, as has its cotyledonary leaves, the other is out. ~~The one with the hanging tip of~~ ~~is dead~~

Culture 173. None of the superficial seedlings dried up in pot, though some have not yet got their radicle into the soil. In a dry atmosphere many would undoubtedly have dried up.

Cultures 157A, 157B. Repotted yesterday in the following: peat 5, glass sand 1, loam 1, by Mr. Wagner.

Culture 208. One twig cutting taken out, no callus, partly dry above, the buds dead. Only three cuttings with leaves. Front 3 root cuttings taken out, two without callus, one callused at one end.

Culture 210. Plants purpled somewhat for several days on the older leaves.

Culture 211. Plants slightly purpled on a few of the old leaves; growing fast now [illegible]

Oct. 23, 1909

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Culture 202 A. South cutting, with neither callus nor other evidence of life without, take at the two cut ends, Next cutting with two buds formed and growing one accidentally broken off, replaced a [illegible]

Then broken been off apparently alive within,

short growth apparently a rootlet at the base end. Next cutting with buds pushing from beneath the [illegible] on the rootstock, one rootlet about 3 mm long, replaced.

Culture 196. Three cuttings taken up, rootlets on two.

Culture 197. One sprouted cutting taken up, rootlets begun

Culture 196. Five more cuttings taken up, two callused, three not; replaced, the two callused to the east.

Oct. 23, 1909

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Culture 210. Eight plants taken out of the flat to-day, all but one gnawed off beneath the surface, the other one with the roots dead and brown. Nine plants now gone altogether.

Culture 211. Two more plants removed, one with the root gone, the other injured.

Culture 216. Remaining stem cut back to within about half an inch of the bud.

Culture 171, 172, 174. Several plants examined. Roots in none at the wall of the pot.

Culture 202. Bud on one cutting swelling, two cuttings taken up, no rootlets yet.

Culture 203 Bud on one cutting swelling.

Culture 203 A South root cutting callused on one end. Next root cutting slightly callused and several white globular bodies formed on the surface, having pushed through the bark.

Culture 207 A. South cutting cut callused, root with a good callus around one end, next not callused.

Culture 205 A. South cutting with good callus on one end, [illegible] buds pushed through bark.

Oct. 23, 1909.

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217. An old plant of Vaccinium pallidum received by express from Linville, North Carolina, secured on Mountain. Set out in one end of a "six-inch flat" with bottom layer of coarse ashes in kalmia peat 4, glass sand 1, and placed in the propagating frame

217 A [Same as 217]

218. [Same as 217 to the end of "six inch flat", [illegible] and placed outdoors under a slat shade"

218 A [Same as 218]

219 [Same as 217 to end of glass sand 1" and add "in a 6-inch window box 14 by 20-inches inside and placed outdoors under a slat shade.

220. [Same as 219]

Cultures 215. Third plant from front with uppermost bud swelling.

Oct. 2[illegible], 19[illegible]

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Culture 98, Nineteen plants now growing. No others apparently germinating.

October 25, 1909

Culture 211. Six more plants taken out. In some the roots seem to be merely dead and dry. In two the root was cut quite off, and a sort of wire worm was found near by. The rootless or root dead plants may be detected by a slightly flaccid appearance, not fully withered. Transpiration evidently slow. Fifteen plants now gone from this plot.

Experiment. When the 1909 blueberry seedlings are ready try planting some of them in thumb pots in pure sand, and plunge the pots in a damp peat to see if the peat water will feed the plants through the wall of the pot. Check with similar pots plunged in sand.

Culture 201. Two plants are now gone from this flat. Two of the live plants have their upper-most leaf partially withered, and ~~many of~~ others look as if stagnation might be occurring. None of the plants looks as if it were growing freely.

Culture 197. Three cuttings taken up to-day, all beautifully callused, but not rooted. One put back, two potted in thumbpots, taken out of glass inside of bell jar and put under the bell glass with the cuttings.

October 25/1907.

Culture 193. No more seeds germinating. Third foliage leaf forming. Glass removed.

Culture 198. No more seeds germinating. Largest seedlings making second leaf. Glass removed.

Culture 59. Cotyledons [illegible] and plant nearly erect in 3 seedlings. Three [illegible] seedlings, probably Sagbusenis [illegible] set [illegible] in a new place [illegible] of [illegible] moist.

Oct. 26/1907

Culture 211. Three more plants found with roots apparently rotted off.

Culture 201. One more plant found with [illegible] the root. Nearby in the soil was found a white larva about a centimeter long with a [illegible] head of four triangular brown teeth at the [illegible] of its body.

Culture 207. At least five of the plants show healthy third foliage leaf.

Culture 215. Second, third, and fourth plant [illegible] primary bud slightly swollen.

Heavy frost last night.

Culture 159. [illegible] [illegible] [illegible] [illegible] plants [illegible] the first five and [illegible] of the [illegible] [illegible] cotyledons [illegible] of ground and [illegible]

Oct. 27, 1909

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Culture 182, 185, 186 and the plants of 11, 17, 21, and 70, all in the little greenhouse, cut back to day to stubs, just above the bud. All the plants had started except 11.

In Leucothoe as shown in [illegible]

Culture 211, Culture 164 Leaves before expanding incurved in a cylinder, the edges meeting but not overlapping.

Culture 210. Leaves revolute before expanding, in cross section thus 

Four more plants eaten off at the root, the plants kept to see how long they will remain without dying out. Two more found with roots rotted off.

Culture 209. One more plant found ~~with~~ eaten off at the surface of the ground and larva of wire worm type found in soil. The plants roots may have been bad before they were eaten as the color is bad and the [illegible] [illegible] dead.

Culture 207. All nine seedlings with cotyledons out of the ground and free of the seed. Two more seed boxes have appeared.

Oct. 27, 1909

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Culture. Stanley bush seeds preserved in a bottle from the same lot sowed, were examined to-day. The larger seeds ~~are~~ about 1.2 mm. long. The embryo is minute, white, straight, nearly cylindrical, about .5 to .6 mm. long, about a fourth that length in diameter. It lies imbedded in a great mass of white endosperm.

The reason why these seeds require so long a time to germinate, about six weeks, undoubtedly is because the embryo must have time to grow to a much larger size than it has attained at the maturity of the berry before it is ready to push open the seed coats.

Oct 28, [illegible]

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Culture 195. Seedlings preserved [illegible] dry for examination
for my [illegible]

Culture 105. One dead plant brown [illegible]

Cultures 105 Pots taken out of the [illegible]
plunging and plunged in sand.

Culture 105 A [Same]

135 "
135 A "
138 "
138 A "
133 "

Oct. 30/1919

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Culture 179, all the eleven seedlings with the cotyledons free.

Culture 221, Dendrium prostratum seeds sowed to-day in a ten-inch pan of Kalmia peat 8, sphagnum moss 1, sand 1, fine sifted, yesterday; placed in the propagating frame.

Photographs

~~Kalmia plants~~
~~Budded blueberry~~
~~Vaccinium membranaceum~~
~~Cold frames.~~
~~27-inch plant.~~
~~Flowering buds, natural size~~
~~Rose soil plant~~
~~Forest leaf mold plant Cutting 111~~
~~Kalmia soil plant " 108~~
~~One year old cutting plant~~
~~Stem base, natural size~~
~~Grafted plant, (cutting 122)~~

Nov. 1
Cutting 77, nat. size (rose soil)
" 134 " " (Kalmia)
~~213 " " (bud)~~
133 1/3 (cuttings)
558 small (leaf ... size plants)
58 nat. size (broad-leaved type)
[illegible] [illegible]
[illegible] [illegible]
[illegible] [illegible]
182 " " (Seedling of 1911 seedling)

Cultivi - 7.   Nov. 4, 1909

Yesterday a new seed leaf appeared.

On Nov. 5 another seed leaf appeared. One of the earlier plants eaten off, leaving now twelve.

Photographs

Nov. 2.

Collema 1/4 nat. size

Cuttings 133 1/4 nat. size ([illegible])

90 1/4 nat. size (Vac.-[illegible])

56 1/3 nat. size ([illegible] budded stump)

213 nat. size

Coldframes

Nov. 3.

Coldframe

Nov. 4, 1909.

Culture 227. Twenty-five root cuttings from the Brooks bush, received yesterday, placed to-day in white sand in a pan drained with kalmia peat, and set in the outside ~~of the~~ propagating frame.

Culture 228. Fifty root cuttings from the Brooks bush, received yesterday placed to-day in yellow sand from the propagating house in a pan, drained with kalmia peat and set in the outside propagating frame.

Nov. 5, 1909

Culture 229. Twenty-five root cuttings from the Brooks bush, received Nov. 3, placed to-day in half sifted kalmia peat, half ~~[illegible]~~ sand, in a pan, in the propagating house.

Nov. 4, 1909

Culture 222. Six twig cuttings from the Brooks bush received yesterday, placed in yellow sand under a bell jar ~~in~~ in the propagating house to-day.

Culture 223 Thirteen root cuttings about 1 inch long by 1/4 inch thick, from the Brooks bush received yesterday [etc as in Culture 222]

Culture 224 Ten top ~~stem~~ cuttings from the Brooks bush received yesterday, placed in white sand in the propagating frame to-day

Culture 225 Forty-eight root cuttings from the Brooks bush received yesterday, placed in white sand in the propagating frame to-day.

Culture 226 Fifteen stem cuttings from the Brooks bush received yesterday, placed in a ~~[illegible]~~ box of white sand with kalmia peat drainage, and put in the outside propagating frame.

Nov. 8, 1909.

In regard to the maintenance of acidity in blueberry soils the influence of an annually renewed surface supply of freshly killed organic matter should be considered. The thorough decomposition of organic matter, as in the Bussey leaf mold, produces a neutral soil. May not a surface layer of dead leaves produce in the early stages of decomposition ~~[illegible]~~ a soil moisture solution of ~~[illegible]~~ acidity ~~to~~ reaction which, percolating through the underlying layers of dead and partially decomposed leaves maintains them also in a condition of acidity and stops their ~~[illegible]~~ decomposition ~~[illegible]~~ reaches the neutral stage? And ~~are~~ not oak leaves, perhaps because of their tannic acid, parti

Nov. 8 '98

Culture 193. Fifth foliage leaf developing on some of the plants.

Culture 207. Four leaf cuttings removed to-day, not callused

Culture 202. Front cutting ~~taken off~~ to-day. Buds and roots started.

Culture 203. Front cutting taken off today. Buds have burst through the bark — the part beneath the sand.

Culture 204. Front cutting taken off to-day. Rootlets have started

Culture 205. Front cutting taken off, not started, but alive.

Culture 178. Three cuttings, the leaves fell, the stem found to be rotted, removed. Three other cuttings, callused, ~~remained~~ and [illegible] rest.

Nov. 9, 1908.

Culture 205. Six two cuttings taken out to-day dead. All callused. Three with stems still green left in bed.

No. 30 cuttings with sprouts above ground. First three dug up, examined and replaced; first with the sprouts about 1 mm long, second and third callused but not sprouted.

Culture 194. Three cuttings brown and dead removed. ~~They~~ Two have a small callus, one a large one. Two are still green at the tip, having died ~~from~~ from the base upward.

Culture 213. Bud of the stock ~~started~~, rubbed off with the idea of forcing the budded bud if practicable.

Culture 209. Epigaea. Nineteen plants remaining, all of which appear to be growing. Most of them have three foliage leaves and the largest one has four.

Culture 211. Sixty five plants living, ~~and~~ mostly in good condition and growing. One plant removed roots rotted.

Culture 201. Eighty plants living, in good condition, growing.

Nov. 9, 1939

Inglea plants shipped from ~~Belgium~~ H. M. Harding Boskoop, Holland, to the Department ~~had~~ cylindrical balls on the roots ~~about~~ 4 to 5 inches long (high) and about 9 inches in diameter. The spread of the branches in some of the larger plants was over two feet, the trunk diameter nearly an inch. The material of the soil was a mixture of sand and peat like soil containing many dead and partially decomposed plants of Polytrichum.

Culture 164. Twenty six plants living and growing, apparently in good condition.

Culture 210. One plant with rotted roots removed. Sixty eight plants left in the bed, but in general much freckled and suggesting an unhealthy condition.

Culture 197. A second seedling came up — the large one and its cotyledons are now expanding.

Culture 187. Another seedling of [illegible] [illegible].

Culture 186. Fourth foliage leaf on larger plants.

195. Second foliage leaf developing on some of the plants.

Nov. 17/909.

Culture [illegible] [illegible] [illegible] [illegible] [illegible] of [illegible] 1/2

[illegible]

Nov. 17, 1909.

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BIONOMIC INVESTIGATIONS.

~~Note.~~

Culture 230. Seven plants from Culture 198, transplanted to an eight inch pan in coarse-sifted kalmia peat 9, fine sifted [illegible] 1. Plants about .5 to 1 cm high, with 3 to 6 leaves. House no 1 about 60 to 65 at night

Culture 231. Seven plants from Culture 198, transplanted to an eight inch pan in coarse-sifted kalmia peat 10. Plants 4 to 5-leaved, averaging a little larger than those of Culture 230, House no 1, about 60 to 65 at night.

Culture 198. Five plants all that are left after taking out 230 and 231 transplanted to an eight inch pan in coarse-sifted kalmia peat 10. Plants 3 to 5-leaved. House no 1, about 60 to 65 at night.

Culture 157. The cutting potted on Oct. 8 with a big callus but no roots, is dying except the tip. Discarded. This leaves only two cuttings rooted from 157.

Culture 208. One of the root cuttings has [illegible] sent 2 shoots out of the sand, [illegible] 7 mm. above the surface. Only two twig cuttings now alive

Nov. 18

Culture 194. Dead except the tip, basally.

Culture 194. In many cuttings ~~[illegible]~~ the large alternate buds are dead and brown. In a few cuttings the buds seem to be pushing.

Calluna vulgaris. Plant repotted today in a 6-inch pot with upper [illegible] in pure kalmia peat. The old ball had a cake of roots at the surface of the pot. To go to the cold house.

Culture 233. Seven plants from Cutting 193 transplanted to a pan in pure kalmia peat. Plants 8 to 20 mm high, 5 to 7 foliage leaves. To go in cold house.

Culture 232. Seven plants from Cutting 1[illegible] transplanted to a pan in kalmia peat & manure. Plants 7 to 15 mm high, with 5 to 7 foliage leaves. To go in cold house.

Culture 234 Seven plants from Cutting 193 transplanted to a pan in kalmia peat. Plants 7 to 15 mm high, with four 4 to 6 foliage leaves. To go in cold house.

Culture 235. Eight ~~cuttings~~ rooted cuttings from 196, potted to-day in 4-inch pots, peat & sand, to go in cold house. One has no ~~root~~ new growth. Others each much new growth made some time ago, & 2 to 6 in. long.

Culture 100. Taken out of thumb pot, plunged in sunny out-doors, and potted in 4 inch pot, with 2 sods, in peat & sand 1. Leaves (eight) still remaining on the plant, but purple, exists seemingly like a seedling. To go ~~back in~~ in cold house. ~~out~~ ~~in~~ ~~cold~~.

Culture 236 Nine ~~ff~~ rooted cuttings from Culture 196, potted to-day in 4-inch pots, peat 8, sand 1, manure 1, to go in cold house. Three may have new growth with leaves.

Culture 196. Seventeen ~~plants~~ rooted cuttings taken out as Cultures 235 & 236. Remaining eight put back in the propagating frame, four with baby new growth. E

G. & G.

Nov. 19, 1904

Culture 197. ~~[illegible]~~ All the cuttings of this number taken out of the propagating frame to-day. One without shoot, but callused and alive, thrown away. Remaining seven potted in peat & sand 1, 4-inch pots. To go in cold house.

Copied Nov. 19, 1909.

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Experiments in Blueberry Culture.

In the grounds of the Smithsonian Institution at Washington are two blueberry bushes* of large size and great age. The taller is about three meters (nine feet) in height. The largest stem is [illegible] mm. ([illegible] inches) in diameter. It is known that these bushes were growing prior to 1871, 38 years ago, and all the evidence indicates that they ~~[illegible] to the early planting~~ were planted at a much earlier date. They ~~blueberry~~ ~~[illegible]~~ are undoubtedly over 50 years old. In the Arnold Ar-

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* The plants are Vaccinium atrococcum, a species closely related to Vaccinium corymbosum, the well known swamp or high bush blueberry of the northern states. In a list of the trees and shrubs of the Smithsonian grounds prepared by Arthur Schott

(over)

in 1871, these beds are mentioned, but incorrectly [illegible] as [illegible] *[illegible]*. Mr. George H. B——, for more than a generation the superintendent of planting in the parks of Washington, assures me that these plants were not set out until he first became responsible for the Smithsonian grounds, in 187[illegible]. The present plan of the grounds was made by Andrew J. Downing, but the actual planting was not done until after his death, in 1852. It is possible that the Blueberry bushes may have been set out as early as 1858, in which year a partial planting of the Smithsonian grounds was made, by Mr. John Douglass.

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boretum near Boston are many blueberry bushes 5 feet or more in height, grown from the seed by Mr. Jackson Dawson. The oldest of these plants were started in 18 and are now therefore years old. The two cases have cited demonstrate the fallacy of the popular idea that the blueberry cannot be transplanted or cultivated. And if they can be grown as ornamental plants why can they not be grown successfully for their fruit?

Four ~~two~~ agricultural experiment stations, those of Maine, Rhode Island, New York and Michigan, have attempted to grow the blueberry as a fruit, but none of these attempts has resulted in commercial or even experimental success.

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That the market would ~~welcome~~ gladly pay a high price for a cultivated ~~berry~~ blueberry of superior quality there can be no doubt. In the Boston market there is a wide difference in the wholesale price of blueberries. Shipments begin in early June ~~with~~ from North Carolina, followed in the latter part of the month by berries from Pennsylvania, ~~and~~ New Jersey, and New York. In early July, or in some years in the last days of June, Massachusetts and New Hampshire shipments begin to arrive, succeeded in late July or early August by berries from Maine, Nova Scotia, and New Brunswick. Receipts from these last two localities continue until late September. The blueberries that bring the highest price are those from Mass.

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chusetts and New Hampshire. At the time when other berries are selling at ~~8 to~~ 15 cents per quart wholesale, the first shipments of New Hampshire ~~boxes~~ of ... bring 20 to 23 cents.

~~The~~ The owner of a blueberry pasture in southern New Hampshire who superintended ~~the picking of~~ his own berries and shipped ~~ed~~ them ~~to~~ to one of the seaboard New England cities, has courteously shown his shipment records, from which the following data ~~information~~ have been compiled.

Year	Dates of shipment	Total shipments (quarts)	Range of prices (cents per quart)	Average net price[v]
1905	July 1 to August 14	2233	12 to 8	10.7
1906	July 13 to August 5	2756	15 to 8	9.6
1907	July 20 to August 15	2338	14.5 to 11	12.2
1908	June 29 to August 15	3602	16 to 9½	10.8
1909	July 15 to August 16	1255	14 to 9	10.7

[v] This is the net price that the shipper received, ~~by the shipper~~ after deducting ~~express~~ charges.

The average net price for the five years was 10.8 cents per quart.

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This record indicates the substantial returns that are secured from ordinary wild berries picked and sent to ~~marketed~~ in ~~a~~ ~~rather~~ better than ordinary condition.

~~The features of superiority qualities desired in a blueberry, from the market standpoint~~

From the market standpoint the features of superiority in a blueberry are large size; light blue color, ~~.......~~ due to the presence of a dense bloom over the dark purple or almost black skin; plumpness, that is, freedom from the withered or wrinkled appearance that they begin to acquire ~~after they have been picked for~~ several days after picking.

dryness, or freedom from superficial moisture, especially the fermenting juice of broken berries, and

While the connoisseur in blueberries, who picks his own fruit, ~~knows~~ knows the widely varying flavors in the berries of different bushes, the buyer in the city market is content to select his ~~purchase~~ fruit according to its appearance, knowing that the flavor will be good enough in any ~~event~~. The size

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While ~~huckleberries~~ are mostly black and blueberries mostly blue*

of the seed gives the ~~New England~~ buyer in the New England markets very little concern, for there the name blueberry is restricted to plants of the genus Vaccinium, all of which have seeds so small as to be unnoticeable when the berry is eaten, while the name huckleberry is applied with nearly the same precision to the species of the ~~[illegible]~~ genus Gaylussacia in which the seed is surrounded by a bony covering like a minute peach pit, that crackles loudly between the teeth. In southern cities the fruits of both Vaccinium and Gaylussacia ~~[illegible]~~ are called huckleberries, and it is probable that the low estimation ~~of~~ in which the fruit of Vaccinium is there held ~~[illegible]~~ is due to the lack of a distinctive ~~[illegible]~~ popular name. To distinguish them by their appearance is ~~difficult for~~ ~~[illegible]~~ any but an expert for some of the blueberries, or species of Vaccinium, are black, and some of the huckleberries are blue, ~~particularly~~ notably Gaylussacia frondosa

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a species often abundant in the sandy soils of the Atlantic coastal plain, which has a large fair berry of beautiful light blue color and passable ~~[illegible]~~ flavor, but the miserable crunching ~~[illegible]~~ seed pits characteristic of ~~that other true huckleberries~~ ~~its immediate botanical relatives~~.

The blueberry withstands the rough treatment ~~is as well as an excellent~~ ~~shipper~~ incident to shipment so much better than most other berries that, with good handling, it should reach the market in any ~~[illegible]~~ but first-class ~~good~~ condition. But its good shipping qualities are often abused and the fruit ~~[illegible]~~ not infrequently is exposed for sale badly crushed, the berries covered with sour juice and made further offensive by the presence of flies. ~~Usually this condition~~ This is the prevailing condition of blueberries and huckleberries in the markets of Washington, in striking contrast with the big plump ~~[illegible]~~ ~~[illegible]~~ berries of the Boston market. This bad condition is due usually to improper picking. The small size of the blueberry, compared with other berries, renders the picking of it expensive. The owners of

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blueberry pastures ~~usually~~ commonly pay ~~their pick~~ two-thirds the net price of the berries to their pickers.

In order to reduce the cost of picking, various devices have been employed. The most widely used of these devices ~~these~~ is an implement known as a blueberry rake, a scoop shaped somewhat like a deep dust pan provided ~~armed~~ in front with a series of long pointed ~~teeth~~ fingers of heavy wire. With this implement an ordinary picker, in the blueberry canning districts of Maine, frequently gathers to bushels per day, for which he receives about cent per quart. Blueberries can be picked with a rake at about a fourth or a fifth the cost of picking by hand. For this reason many of the berries that go to market are picked with a rake and it is these berries which, broken and fermenting, make up the greater part of the low grade

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stock so offensive to the eye and the taste. Blueberries intended for the market should never be picked with a rake.

~~For~~ What has been said regarding the high cost of picking ordinary blueberries by hand indicates the importance of securing a berry of large size if the plant is to be cultivated. Large size and abundance means a great reduction in the cost of picking. Large size ~~It also~~ means also a higher market price and when taken in connection with good color and good market condition, it means a much higher price. ~~larger financial returns~~

The ~~writer's~~ interest was attracted to the subject of blueberry culture in 1906, in the autumn of which year some experiments were made for him by George W. Oliver to ascertain a suitable method of germinating the seeds. In the autumn of 1907 the cultural experiments began.

[illegible]

New Hampshire

In 1908 began experimentation ~~with~~ in the propagation of bushes bearing berries of large size, the most satisfactory of these being of bush of the swamp blueberry, Vaccinium corymbosum ~~though not the largest~~ having berries a little more than half an inch in diameter. The largest berries tested, were from Oregon bushes of Vaccinium membranaceum a little more than five eighths of an inch in diameter. Except where otherwise stated, the experiments ~~to be~~ described in this paper were made with Vaccinium corymbosum. The principal results of the experiments are given under brief numbered statements, each followed by a detailed explanation.

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(Blueberry)

S[illegible]

[illegible] experiments

~~[illegible] with [illegible] [illegible] Superiority of New Hampshire [illegible] large size, pale blue color, [illegible] thickness and freshness, freedom from external moisture. Cost of [illegible] (New Hampshire [illegible]), tendency to [illegible] by use of [illegible] as in [illegible] [illegible], [illegible] on market, [illegible] better than [illegible] [illegible] and in [illegible], especially large size, and they must be marketed in good condition.~~

Experiments

Interest [illegible] this subject in 1906, [illegible] of that year some experiments were made [illegible] further [illegible] by Mr. George [illegible] to [illegible] a suitable method of germinating the seeds. In [illegible] of 1907 the cultural experiments began. The [illegible] of these two years of experiments may be briefly [illegible] as follows:

Begin a new page in each new statement

1. The swamp blueberry does not thrive in a rich garden soil of the ordinary type.

2. The swamp blueberry does not thrive in a [illegible] soil.

3. The swamp blueberry does not thrive in a [illegible] soil [illegible] by lime.

~~[illegible]~~

4. The swamp blueberry does not thrive in a clayey soil.

5. The swamp blueberry does not thrive in a thoroughly [illegible] [illegible], such as has a neutral reaction (or

~~4~~ 6. The swamp blueberry does not thrive in a soil having an alkaline reaction.

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7 ~~5~~. For vigorous growth the swamp blueberry requires an acid soil.

8 ~~6~~. The ~~favorite type of~~ acid soil for the swamp blueberry is ~~acid~~ peat.

9 ~~7~~. ~~Acid~~ Peat ~~suit~~able for the swamp blueberry may be found either in peat bogs or ~~on~~ the surface of the ground in sandy oak ~~or~~ pine woods.

10 ~~8~~. For active growth the swamp blueberry requires well aerated soil. Conversely, the swamp blueberry does not continue in active growth ~~in a soil~~ saturated with water.

11 ~~9~~. Aeration conditions satisfactory for blueberries are prevalent in sandy soils.

12 ~~10~~. Aeration conditions satisfactory for the swamp blueberry are found in drained fibrous peat.

13 ~~11~~. Aeration conditions satisfactory for the swamp blueberry are found in masses of live moist but not submerged sphagnum.

14 ~~12~~. The swamp blueberry is devoid of root-hairs, the minute organs through which the ordinary plants of agriculture absorb their moisture and food.

15 ~~13~~. The rootlets of ~~heath~~ plants of the swamp blueberry ~~plant~~ are inhabited by a fungus, of the sort known tech-

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nically as an endotrophic mycorhiza.

16. ~~14~~ The mycorhizal fungus of the swamp blueberry appears to have a beneficial effect upon the blueberry plant.

~~15 The evidence at hand~~

17. ~~15.~~ The acid peaty soils in which the swamp blueberry thrives are deficient in available nitrogen, although containing large amounts of non-available nitrogen.

18. ~~16.~~ The deficiency of available nitrogen in the acid peaty soils in which the swamp blueberry ~~thrives~~ is due to the inability of the ~~nitrifying~~ nitrifying bacteria to thrive in such a soil, because of ~~their~~ its acidity.

19. ~~17.~~ From the evidence at hand the presumption is that the mycorhizal fungus of the swamp blueberry transforms the non-available nitrogen of peaty soils into a form of nitrogen available for the nourishment of the blueberry plant.

20. ~~18.~~ From the evidence at hand the presumption is that the mycorhizal fungus of the swamp blueberry transforms the free nitrogen of the atmosphere into a form of nitrogen available for the nourishment of the blueberry plant.

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21. ~~The~~ Seedlings of the swamp blueberry are grown readily by proper treatment. Seeds sown in August from fresh berries germinated in about six weeks and produced seedlings which, after passing the winter in a greenhouse, ~~grew into~~ grew into robust plants of a maximum height, at twelve months from germination, of 27 inches.

~~20 The swamp blueberry may be propagated by grafting, by budding, by layering, and by cuttings.~~

22. ~~20~~ Seedlings of the swamp blueberry carried through the first winter ~~in~~ in the greenhouse have shown from to per cent of fruiting plants at two years of age. Occasionally a plant flowers at one year of age.

23. ~~21~~ The swamp blueberry may be propagated by grafting, by budding, by layering, and by twig cuttings. and by root cuttings.

24. ~~22~~ The most satisfactory method of propagating the swamp blueberry is by cuttings.

25. ~~23~~ Experiments have been begun on the field culture of the swamp blueberry.

whether with wild plants, or with seedlings, or with plants grown from cuttings, 15

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BIONOMIC INVESTIGATIONS.

To those desiring to experiment with the field culture of the swamp blueberry, two modes of treatment are suggested, both deduced from the experiments already made. The first method, suited to upland ~~soil~~ is to set the plants in ~~early spring~~ trenches or separate holes in well rotted peat a foot in depth, and mulch the surface well, either with leaves or preferably with clean sand. The excavations should provide ample space ~~be not less than a foot in depth~~ for new growth of the roots, not less than a foot each way from the surface of the old root ball. The peat used, ~~should be of the character~~ described on pages to of this report, and preferably should have may be of either the bog or upland type, as been rotted for several months before using. If only fresh peat is available the addition of one

The reason for [illegible] is discussed on pages to .

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tenth part, by bulk, of well rotted cow manure is recommended. This should be very thoroughly comminuted and mixed with the peat. The soil in which the holes or trenches are situated should be such as to provide good drainage, the ideal condition of the peat about the roots of the plant being one of continued moisture during the growing season, but with all the free water draining away readily so that thorough aeration of the mass of peat is insured.

? If ~~such a~~ the surrounding soil is sufficiently porous moisture and aeration condition ~~can be maintained~~ without the necessity of mixing sand with the peat, better growth, it is believed, will be secured than when such mixture is used.

The second method, [illegible] is to set out the plants in [illegible]

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and deeply mulched with sand. The treatment proposed is the same as that employed in cranberry culture except that no special provision need be made for flooding the bog in [illegible] winter. The bog may probably be kept with advantage in a drier condition than is usual with cranberries.

This method of culture is suggested not only because of the close botanical relationship of the swamp blueberry and the cranberry, and the known similarity of their physiological requirements in the matter of peat, the moisture, as well as the presence of a mycorhizal fungus in the roots of both, but also and especially because the most robust growth in all the pot experiments occurred when the [illegible] were seedlings grown in peat and the roots were surrounded by moist

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sand. The important effects of these conditions are discussed on pages Essentially the same effects, it is believed, are secured by the system of culture used for the cranberry.

The writer wishes to make one suggestion to those intending to experiment with the culture of the blueberry, namely that before beginning their operations they read carefully the whole account of the experiments recorded in this publication. These plants differ in their soil requirements so fundamentally from all our common cultivated crops that it is useless to expect to succeed with their cultivation without a thorough understanding of the principles governing their growth.

A limited number of seedlings

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grown from a bush producing berries a little more than half an inch in diameter in most instances and will be sent to several experimenters if satisfactory arrangements can be made regarding their culture. On the basis of our earlier seedlings showing wide variation from the parent type it is not expected that the fruit of these later seedlings will be uniformly large but it is hoped that some of them will at least equal the half inch berries of the parent. No rooted cuttings are yet ready for distribution.

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1. The swamp blueberry does not thrive in a rich garden soil of the ordinary type.

Although the statement just made might well rest on the direct observation of experimenters who have failed to make blueberries grow luxuriantly, or sometimes even to remain alive, in ~~rich~~ garden soils, nevertheless the citation of one of the writer's experiments may serve to accentuate the fact. The soil chosen for the purpose was the one used at ~~in the gar~~ ~~houses of~~ the Department of Agriculture for growing roses. A sample of this soil, as mixed by the rose gardener, consisted of five shovelfuls of loam, one shovelful of cow manure,

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and a handful of lime". The loam used was a rotted grass turf grown on a rather clayey soil. The cow manure was well rotted, having lain in the pile for several months, with almost no admixture of straw. The lime was of the ordinary unslaked sort.

The pots used in the experiment were of glass, ordinary 5-ounce whiskey glasses, about 2 inches in diameter at the bottom, 2 ½ at the top, and 2 ¾ inches deep. A small hole bored through the bottom gave the necessary drainage to the soil in the pot. Since the walls of these pots were transparent, the normal growth of the ~~grain~~ roots, and the prevention of an obscuring growth of microscopic algae, required some arrangement for keeping light away.

or, as gardeners say, "plunging,"

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No 9

This was accomplished either by burying,
the pots nearly to the rim in sand, moss, or soil,
or, when the pots were not plunged,
by fitting closely to the outside of each a
removable cuff, as it were, made of the ~~gray~~
opaque gray blotting paper used
in pressing specimens of plants.
The use of a pot with transparent
walls was found to be of very great
importance in the study of these
plants, for plants identical in appearance
so far as the parts above ground
were concerned sometimes showed
the most pronounced differences
in the growth and behavior of the ~~follow~~
roots, differences ~~that were~~ ~~ultimately~~
which otherwise would not have been observed but
which were in reality responsible for the
~~by~~ conspicuous changes that later took place in the growth
of the ~~parts above ground~~ stems and leaves. The use
of such glass pots, trained and darkened,

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is strongly recommended to plant experi-
menters who use pot cultures, ~~for they~~ they afford easily
as a means of ~~acquiring~~ acquiring an inti-
~~will then be able to~~ great information in the
mate knowledge of the behavior the feeding organs, the
of roots, under different conditions.

On December 22, 1909, six glass pots
were filled with the garden soil de-
scribed above, ~~a mixture of humus, sand,~~
~~and lime~~, and a seedling blue-
berry about an inch in height was trans-
planted into each. The seed bed from
which the seedlings were taken had
been allowed to become partially dry
before the transplanting was done. In
this condition there was no difficul-
ty in removing all of the sandy soil
adhering to the roots of a seedling, so that after trans-
planting the plant must derive its soil nourish-
ment from the ~~new~~ soil exclusively.
In potting, the roots of the plant were
laid against the glass on one side of

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the pot so that their behaviour could be observed from the very first.

A transplanting of six other plants was then made, similar in all respects to the first except that the soil used was a peaty one known from earlier experiments to be productive of vigorous growth in blueberry plants. The exact character of this soil will be discussed later in this publication.

Now this peaty blueberry soil is ill suited to the growth of ordinary plants, while in the garden soil ordinary plants flourish luxuriantly. In order to bring out this fact six glass pots containing this garden soil were planted with five alfalfa seeds each, and six more with one rooted rose cutting each. An identical planting was made in twelve pots of blueberry soil.

Average examples of the growth that took place in these plantings are shown in Plates 1, 2, and 3. In the garden soil the rooted rose

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cutting, which was of the variety
known as Cardinal, made vig-
orous growth of both root and stem,
and in 44 days, when the photo-
graph was taken, had about quad-
rupled its leaf surface. In the
blueberry soil the cutting was barely
alive, the roots it had at the time it
was potted were nearly all dead, the
leaflets it bore were only those still
persisting from the parent plant.
no new stem growth had been
made, and

The alfalfa seeds began to germin-
ate in both soils in three days. At
the end of a week a distinct difference in
the color of the plants was discernible.
In the blueberry soil the seed leaves were
notably darker green in color, the mid
rib, which shows on the back of the leaf

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was purple, the stem was purple, and in some of the seed leaves the whole under surface was purple. In the garden soil the seed leaves were notably lighter green in color, and in only a few were the stems, and in still fewer the midribs, somewhat purplish. At the end of 44 days, when the photographs reproduced in Plate 2 were taken, the alfalfa plants in the garden soil were three inches in height and vigorous, while the soil was crowded with roots on which nitrogen tubercles had already begun to develop. In the blueberry soil the plants ~~were~~ small leaved and sickly, about a third the height of the others, and the roots though long were slender and otherwise weak, and bore no tubercles.

With the blueberry plants the relative growth in the two soils took exactly the pho-

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site course. At the end of the first week new root growth had taken place in all the pots containing blueberry soil while in those containing garden soil new root growth was apparent in only one. At the end of 44 days vigorous root growth had taken place in the blueberry soil pots, and stem growth, which had been interrupted at the time of the transplanting, was well under way. In the garden soil, however, almost no root growth was discernible, the old leaves were strongly purpled, and stem and leaf growth had not been resumed at all. Little attention was paid to these cultures during the summer of 1909 but the relative condition of the two is fairly illustrated in Plate 3 from photographs taken November , 1909, after the leaves had fallen. The garden soil pot contained only a few

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stray roots, and the slender stems were only
? inches high. The pot containing
blueberry soil was filled with a mass
of roots, ~~and~~ the largest stem was
? inches long, and the weight of
? that part of the plant above ground was
times that of the corresponding part
of the garden soil plant.

Nov. 20, 1907

~~Leaf mold.~~ Four concrete bins have been constructed at Arlington Farm each 6 feet square inside and about four feet high, the bottom of the bins being the natural clayey soil. The object of the experiment is to ascertain the character of leaf mold produced by rotting leaves of different trees.

The south bin (No. 1) is partly filled with leaves of sugar maple from Arlington Cemetery. The leaves are thoroughly wet and tramped down as they are put in.

The north bin (No. 4) is filled with two wagon boxes full of ~~red~~ oak leaves mostly rubra, tinctoria, and coccinea, with an occasional [illegible], alba, minor and marylandica, and [illegible]. Air slaked lime was sprinkled over the leaves as they were put in and a hose was played on the leaves, and they were tramped down hard. Fifty pounds of lime were used on the two wagon boxes of leaves.

Copied Nov. 22, 1909

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2. The swamp blueberry does not thrive in a heavily manured soil.

In May, 1908, two healthy and vigorous blueberry seedlings were sent for trial to one of the agricultural experiment stations. They were set out in a soil that was known to be suitable for these plants, for old blueberry bushes had been growing there for several years. The man who put the blueberry seedlings in the ground, however, misunderstanding the directions sent him, filled the holes in which he set the plants with alternate layers of soil and well rotted stable manure. The writer examined the plants on August 27, 1909, when they should have been either growing vigorously or, with mature

foliage, ripening their wood for the winter.
Instead they had lost nearly all their
older leaves though still maintain-
ing a feeble and spindling growth
at the ends of the larger stems.
The adjacent old bushes growing in
precisely the same soil, except ~~for~~ that
they had not received the ~~ir of~~ ~~heavy~~ bore at the same time
~~the~~ heavy of manure ~~[illegible]~~ vigorous
dark green foliage and were ripen-
ing the wood of their stout twigs, and
laying down their flowering buds for
the following year. ~~The contrast was~~
~~that of thoroughly healthy plants with~~
~~un manured and very sickly ones~~
~~when heavily manured.~~ The manured
plants when dug up and examined
showed no new root growth whatever
in the manured soil outside the old
earth ball, and most of the roots in
the surface of the ball itself were
dead. ~~Another~~ experiment may be cited to show
the injurious effect of heavy manuring.
On ~~[illegible]~~ December 22, 1909, six blueberry

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Gentlemen:

Please call at ____________________

____

for ____________________

____

and deliver the same at ____________________

____

Very respectfully,

____

Chief Clerk.

seedlings were transplanted into as many glass pots in a good blueberry soil, and six other seedlings were potted in the same manner except that to each two parts of blueberry soil one part of well rotted but undecayed cow manure was added. at first ~~for the first three weeks after potting~~ the manured plants appeared, superficially, to be doing better than those not manured, for in the former the production of new leaves and the continued growth of the stem tip was not interrupted by the potting, while in the plants not manured there was a temporary but definite stopping of stem growth immediately after the potting. The apparent superiority of growth in the manured plants, above ground, continued for about three weeks. Meanwhile the roots of the two cultures had been acting in a very

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Chief Clerk.

diverse manner. In the plants without manure new root growth began a few days after potting; At the end of three weeks the development of an extensive root system was well under way, and the plants ~~wave~~ were nearly ready for a period of vigorous stem growth. In the manured plants, however, either no root growth at all ~~took~~ place, or only a slight amount, the new rootlets being fewer, shorter, and stouter than in normal plants. The old rootlets turned brown and appeared to be dead or dying. At the end of five weeks the growth of the tops was very slow. About ten days later, on February 6, a bright warm day, the lower leaves on three plants wilted, ~~on many of the~~ ~~plants~~ and within a few weeks all six of the ~~the~~ manured plants were dead.

United States Department of Agriculture,

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____

for ____

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and deliver the same at ______________________________

____

Very respectfully,

____
Chief Clerk.

Nov. 22, 1909.

Culture 195. A few seeds still germinating.

Culture 175. Three of the cuttings are rooted at the tip and just beneath the surface; [illegible] just above ground, not long up.

Cultures 73, 77. Stems of the two plants photographed to-day were cut off and weighed, green, as follows

2.217 grams, blueberry soil stem (Culture 73)

.043 grams, rose-forcing soil stem (Culture 77)

43) 2217 (51.5
215
67
43

Length of stems
Blueberry soil plant (Culture 73)

Stem 4	28.5 cm
3	21
2	13
1	4
	66.5

Rose soil plant (Culture 77)

Stem 2	5.3
1	3.7
	9.0

9) 66.5
7.4 sq. = 54.2

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Nov. 23, 1909

Culture 130. Lime water bottle as ordinarily filled held 2.4 liters. Filled as follows.

	Mar.		Aug
1	10-	26	24-
2	23-	27	25-
	Apr.		Sept.
3	-22	28	2-
	May		
4	-1	29	8-
5	3-	30	14-
		31	21-
6	8-15	32	27-
			Oct.
7	23-	33	4-
	June		
8	-10	34	12-22
9	12-		
10	17-		
11	21-		
12	24-		
13	28-		
	July		
14	1-		
15	3-		
16	7-		
17	9-		
18	13-		
19	17-		
20	21-		
21	24-		
	Aug.		
22	2-		
23	8-		
24	12-		
25	19-		

One plant destroyed about Sept. 25.

Calcium oxid about 1.25 grams per liter.

Estimate that a third the lime water went through the pots, a liberal estimate.

31 number bottles on 6 plants
2.4 liters per bottle
124
62
74.4 liters — 6 plants
3) 74.4
24.8 liters run through
50 liters leaving lime in 6 plants.
1.25 lime per liter, grams
6) 62.5 grams lime on 6 plants
10.4 grams lime on 1 plant to Sept. 27

3 bottles on 5 plants
2.4 liters per bottle
3) 7.2 liters on 5 plants
2.6 liters run through
5) 5. liters leaving lime on 5 plants
1 liters " " " 1 plant
1.25 grams lime on 1 plant after Sept. 27
10.4 " " " " " before "
12 grams lime on 1 plant Nov. 23 1909.

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Nov. 23, 1909

Culture 130

Height 10 inches

17 1/4 (17 1/4)

11 1/4

16

16

5) 70.5

14. inches, average height

Nov. 24, 1909

Culture 130. Experiment made to-day in putting lime water through the most impervious pot. 50 cc. lime water poured into pot. Began to go through in about one minute. Phenolthalein added, did not redden. Boiled turned pink. Nearly 50 cc. came through altogether. All turned a light pink.

One pot, the smallest plant, turned over to Mr. Breazeale for determining the total lime, to see how this compares with the amount estimated from the watering. In this pot appeared essentially the same phenomenon as in the others, namely a lime crust a millimeter or less in thickness, below about half an inch of black, rootless soil and down the label the same black rootless line.

About an inch of snow this afternoon on the ... blackness.

Nov 26, 1909

Culture 233. Tip of central one eaten off by sparrows, none of other six withered

Culture 234. Tip of one eaten off by sparrows, none of others withered.

Experiment in propagation of blackberries. Cut off plant and let ~~young~~ new shoots arise from the stumps. Then fill in with a foot or so of sphagnum. Keep moist but not wet so that adventitious roots will be ~~[illegible]~~ formed if possible. In the winter following the formation of the roots cut off the stems.

Culture 221. Taken into [illegible] [illegible] no. [illegible]
No germination yet.
Culture 195. Seeds still germinating.
[illegible] No tips withered
Culture 231. No tips withered
Culture 178. No tips withered. Tips of two plants eaten off by a snail
Culture 177. Four plants now up, one with 3 foliage leaves, beautifully [illegible], one with 1 leaf, one [illegible], two [illegible] cotyledons.
Culture 170. Out doors, leaves [illegible], flowering buds [illegible] on one plant, one on the other.
Out door plants [illegible] [illegible]
[illegible] [illegible] [illegible]
[illegible]
from [illegible] or [illegible]
Those near the greenhouse, among the [illegible] of the frame [illegible] holding their leaves best.
Vaccinium macrocarpum has [illegible] no leaves [illegible] nearly [illegible] [illegible].

Nov. 26, 1909.

Culture 237 ([illegible]) Plants plunged in sand ~~and placed~~ in old house. Height of plants as follows. Leaves all shed.

350 mm.
370
360
370
420
285

Culture 238. [same as 237 until measurement] Each plant cut back to a single stem, about two inches high. ~~The remaining~~ Two growing buds on cut off ends. Leaves all shed. Measurements as follows before cutting back.

360
335
350
380
430
375.

Culture 235 Best bud eaten by [illegible].
Culture 232 Take of two eaten off by [illegible] measurements of these five cuttings.

Nov. 26 1919

Cuttings 208. One live ~~root~~ ~~cutt~~ tiny cut-ting left, a dead one callused at the base having been removed to-day.

Cuttings 194. At least eight of the cuttings are dying, showing ~~brown~~ ~~beneath~~ dead tissue near the surface of the sand and beneath.

Cuttings 64 + 64 A. ~~In~~ several plants of these cultures, in the cool cold frame with some heat on, the buds are be-ginning to push.

Kalmia latifolia in the cool cold frame no growth, but leaves much decay and growing them an ... leaves which are somewhat brown spotted in mottled, the youngest killed and brown from freezing.

Bouvardia plants. No showing ~~growth~~ vigorous, in or out of the cold frame.

Cuttings 237 ... → 127 repotted by Miss Evans several days ago in 3-inch pots, from ... 2½ inch pots, in [...]

Pages 1–12 copied Nov 2 [illegible]

3. The swamp blueberry does not thrive in a soil made sweet by lime.

In its natural distribution the blueberry, like almost all plants of the blueberry and heather families, avoids limestone soils. The fertile limestone areas of western New York, of Ohio, of Kentucky, & Tennessee, lack the blueberry, the huckleberry, the laurel (*Kalmia latifolia*), the trailing arbutus (*Epigaea repens*). The State of Alabama, as described by Charles Mohr in volume 6 of Contributions from the United States National Herbarium, is traversed from east to west in the general latitude of Montgomery by a strip of dark calcareous soil, ~~The belt, in which lies the city of Montgomery, has a width of~~ 35 to 45 miles in width, the so-called "black belt", which constitutes the great agricultural region of the state. × ~~The~~ non calcareous areas

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Please call at ____________________

____

for ________________________________

____

and deliver the same at ____________

____

Very respectfully,

____

Chief Clerk.

north and south of this strip have in their forests a characteristic undergrowth of blueberries and closely related plants, including huckleberries, farkleberries, and deerberries,

In the the intermediate belt of black limestone soil just described the plants of blueberry ~~and heath~~ relationship are almost wholly wanting.

In an article ~~by Mr. M. L. Fernald~~ entitled "The soil preferences of certain alpine and subalpine plants", published in 1907 (Rhodora 9: 149–193), Mr. M. L. Fernald all the blueberries he enumerates, five species, avoided calcareous soils, and the other ~~plants~~ ~~species~~ of the blueberry and heather families, almost without exception, likewise occurred on non-calcareous formations.

discusses the natural distribution of over two hundred and fifty species of plants found in the cold parts of the northeastern United States and Canada.

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The writers own experiments in growing blueberries in limed soils have not proceeded with the same smoothness as some of his other experiments, but the results though at first misleading have always been remarkable and in the end exceedingly instructive, though not always in the direction originally contemplated.

On May 26, 1908, six blueberry seedlings were potted in six 14 ounce drinking glasses in a good peaty blueberry soil, in which however one per cent of airslaked lime had been mixed immediately before the potting was done. Six other plants were similarly potted but without the addition of lime. The unlimed plants grew normally. The younger leaves of the limed plants, however, began to wilt the same day. On June 1 all the leaves on all the plants were withered, though parts of the stems were still green and plump. The (over)

during the first few days, but the plants subsequently recovered and made as good growth as could have been expected from the general character of their soil.

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did not turn purplish or yellowish as is usual with sickly blueberry plants, but either retained their green color after withering or turned brown.

for

and deliver the same at

No new root growth took place in any of the limed pots, and by

Very respectfully,

July 10 all the plants were dead.

~~By accident~~ Another series of six plants, also potted on May 26, 1908, but in a sterile soil containing no peat, by accident ~~had~~ received a very small amount of lime. Most of the leaves on these plants withered

Chief Clerk.

From these experiments ~~just described~~ the writer concluded that the blueberry was exceedingly sensitive to lime, that the slightest admixture of it in the soil would be immediately fatal to the life or at least the health of a blueberry plant. This conclusion, however, was erroneous, as subsequent experience showed. This first experiment may therefore be dismissed with the explanation that in all probability the immediate collapse of the plants was due to a caustic effect of the lime used. In none of the later lime experiments did this immediate collapse occur and in none was the lime so applied that it came into contact with the blueberry roots while in a caustic condition.

Still laboring under an erroneous conception of the supersensitiveness of the blueberry plant to minute quantities of lime the writer, desiring to produce fresh examples of this phenomenon, in November, 1908, placed

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____

Very respectfully,

____
Chief Clerk.

a very small quantity, a few milligrams, of airslaked lime on the surface of the soil in each of three 2-inch pots containing a small blueberry plant. No effect was produced, either at first or for several weeks.

On December 19, 1908, a large surface application of carbonate of lime, a gram to each pot, was made and the lime was washed down with water. The expected collapse did not occur. The limed plants continued to grow as luxuriantly as their unlimed neighbors. The conclusion was reached that the reason why the ~~lime~~ growth of the plants had not been affected ~~the~~ was because the lime had not penetrated sufficiently into the soil. Another and more drastic experiment was therefore determined upon.

On March 10, 1909, six blueberry plants in 4-inch pots containing a good blueberry soil were set apart from

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....

Very respectfully,

....

Chief Clerk.

their fellows and watered with ordinary limewater, a saturated solution of calcium oxid, (1.25 grams per liter of water.) The applications made were of such an amount that the soil in the pot was thoroughly wetted each time, and usually a small excess quantity ran through the hole in the bottom of the pot.

For more than seven months, until October 22, 1909, these pots received no other water than limewater. During this period the plants continued to grow in a normal manner, their average height increasing from 4½ inches to 14 inches. The lime appeared to have no detrimental effect whatever on the growth of the plants. An analysis of the soil in one of the pots, (after the limewater applications had ceased) showed that the amount of lime it carried was enormous, considered from the standpoint of ordinary agricultural

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and deliver the same at ______________________________

____

Very respectfully,

____

Chief Clerk.

Passage. [The soil was ___ per cent lime.] ~~After making a liberal allowance of one third for limewater wasted by running out at the bottom of the pot immediately after watering, the computation showed that each pot must have received about 12 grams of lime, or ___ % of the dry weight of the soil.~~ ~~Chemical analysis~~ ~~of the contents~~ of one of the pots after the limewater application had terminated showed ___ grams, or ___ %. ~~of lime~~ This is the equivalent of about ___ tons of lime per acre ~~for a soil having the specific gravity of the ...~~

Now it was known from other experiments, to be described later, that in a soil containing as much as ___ % of lime blueberry plants should either die or barely remain alive. As a matter of fact these limewater plants were making excellent growth. A careful examination of the contents of one of the pots was then made. The surface of the soil was covered with a hard gray crust of lime. Immediately underneath for a depth of about half an

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inch the soil was black and contained no live blueberry roots. There was a zone of the same black rootless soil along the wooden label that reached from top to bottom of the pot. In all other parts of the dark brown peaty soil there was a dense mass of heathy roots which reached down also into the open spaces among the broken crocks in the bottom of the pot. The lime appeared to have penetrated only into the superficial portions of the soil. A chemical test showed that the black rootless layer was densely impregnated with lime, while the brown peaty portion, containing the growing roots, still gave the acid reaction that was characteristic of the whole potful of soil before the limewater applications began.

Since all the water that the

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70) 1200 (17

80) 1200 (15

8.36

limeless, root bearing portion of the soil had received during the preceding seven months had come from the lime-water applications, it was evident that ~~the lime~~ contained in the limewater had been depos-ited ~~in~~ the upper layers of the soil. The ~~following~~ laboratory experiment confirmed this. ~~In an ordinary filter was placed a small quantity of the peaty soil used in growing blueberries. Upon this was poured dilute limewater reddened by the addition of phenolphthalein, a substance that gives a delicate color test for lime. Within~~

A small quantity of the acid peaty soil used in growing blueberries was placed in a glass vessel and moistened. Then dilute limewater reddened by the addition of phenolphthalein, a substance giving a delicate color test for lime, was stirred into the soil, and the mixture poured into an ordinary paper filter.

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The water came through the filter without a trace of red color, showed none after boiling, to drive off any possible carbonic acid, and when tested with ammonia and ammonium oxalate showed not a trace of lime. The precipitation of the lime had been complete and practically instantaneous. Only ten seconds had elapsed between the time when the limewater was added to the soil and the time when the liquid began to drip through the filter.

In order to ascertain whether a large part of the lime in the limewater used on the plants may not have passed through the pots by running down the partially open channel along the label, some ~~full strength~~ limewater was poured upon the surface of one of the pots. The excess water that

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~~came out~~ soon began to drip through the bottom of the pot was tested for lime. It was found that while the limewater poured into the pot contained .1014 ~~per~~ cent of lime, the water that came through contained only .0046 per cent. In other words a pot of soil that for over seven months had been used essentially as a limewater filter still continued to extract over 95 per cent of the lime contained in the limewater ~~to~~ that was passed through it, notwithstanding the fact that there was a partially open channel down one side of the pot. It is believed that had the soil been ~~tightly~~ evenly compacted in the pot no lime whatever would have been able to pass through but that all would have been precipitated in the uppermost layers.

While this experiment has no important bearing on the subject of blue-

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berry culture it is of very great significance in its bearing on the method of applying lime to acid soils in ordinary agricultural practice. A surface application of lime would have no appreciable effect in neutralizing the acidity of a soil unless the soil was so sandy or gravelly or otherwise open that the rainwater containing the dissolved lime could run down through it practically without obstruction. A surface dressing of lime would have little effect in neutralizing the acidity of an old meadow or pasture. To secure full action of the lime requires its ~~Only one~~ intimate mixing ~~of the land~~ with the soil such as can be accomplished by thorough harrowing, especially after ~~the use of a drill or~~ putting the lime beneath the surface with a drill. ~~can produce the~~

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Add to p. 8a Copied Nov. 30, 1909 13

Among the ~~soil mixtures~~ experiments with blueberry seedlings in different soil mixtures started on December 22, 1908, was one in which six plants were set in glass pots in a good blueberry soil to which ~~one~~ 1 per cent of carbonate of lime had been added. The first difference that showed between these and unlimed plants in the same soil was the much feebler root growth of the limed plants. This was followed by an evident tendency toward feebler stem growth. The later progress of this experiment was interrupted, however ~~unfortunately~~, and its average results vitiated because the roots of some of the limed plants found their way through the holes in the bottom of the pots and obtained nourishment from the unlimed material in which the pots were plunged. These plants made nearly as good growth as the unlimed plants. On November 27, 1909, there remained only one of the limed plants whose roots were all inside the pot. This

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plant was small and feeble, its stem
3 being only   inches high. Its ~~con-~~
~~spicuous~~ inferiority to the unlimed plants
~~was~~ almost as conspicuous as that
of the garden soil plants described on
6c) page   and illustrated in Plate 3.

~~Use this matter above only if the soil test 11 and the test of the soil made by Mr. [illegible] on Monday show the culture it is more acid.~~

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G. & G.

Nov 27, 1909

Culture 33 1/3 A layered branch of cutting 120ff, which was cut off from the parent plant last summer. To-day taken out and thrown away, completely dead.

Culture 120 The layered branch removed from the parent last summer is alive though long since [illegible].

Culture 204. The largest plant does not seem to be doing well. The uppermost leaf 40 by 6 mm. is flesh colored toward the base in the medium area and the leaf rudiment is pallid not green. Thirteen of the smaller plants are putting out bright green new growth.

Nov 21 1909

Culture 199. Eight cuttings to-day show dead stems above ground, besides the two taken out by Dr. Erwin F. Smith a few days ago.

Desert Botanical Laboratory
of the
Carnegie Institution

Culture 111

Nov. 29, 1909

× 6	34 1/4	178 1/4
4 3/4	6	
× 8	10 3/4	
× 9 3/4	× 9 1/4	23) 178 1/4 (7 3/4
× 5 3/4	13 1/2	161
34 1/4	9	17
	8 1/2	
	8	
	7 3/4	
	5 3/4	
	3 3/4	
	7 1/2	
	6	
	7 1/4	
	9 1/2	
	8 1/2	
	10 1/4	
	8	
	4 1/4	
	178 1/4	

Average height 7 3/4 inches.

Plants marked X weighed.

Small package — 4.5384 √ pounds.

[illegible] 116 1—6 1/2 Nov 24/17

	9
	13 3/4
	16
14	15 3/4
11 1/2	15 1/4
11 3/4	10
11 1/4	14
10 1/2	15 1/2
11	16 1/4
7 1/4	12 3/4
11	13 1/2
11 1/2	12 1/2
11	14 1/4
10 1/4	
9	
126 1/2	

25)295 (11 3/4
25
45
25
20

Average height
11 3/4 inches

G. & G.

Culture 109 Nov 29 1917

11 1/2
12 1/4
14
6 3/4
14 1/2
15 1/4
12
8 3/4
13
13 1/2
12
14 3/4
14 3/4
6 1/2
11 1/2
10 3/4
11
12 3/4
~~[illegible]~~
~~[illegible]~~
215 1/2

215 1/2
10 3/4
10
8
15 1/2
14 1/4
12
14 3/4
15 1/4
13 1/4
13 3/4
14 1/2
12 1/4
14
17 1/4
12
13 1/2
5 1/2
13 1/2
16 1/4
13 1/2
11 1/2
9 3/4
499 1/2

499 1/2
13
9 1/2
18 3/4
7
15 1/2
4 3/4
10 1/2
14
11 1/4
10 1/4
50)619
12 1/2

Average height
12 1/2 inches

Culture III A   Nov 29/1909

reverse order

8 1/2	132
4 1/2	7 1/2
8	8 1/2
7 1/4	5 3/4
6	4 1/2
8	25) 158 (6 1/4
6	150
7 1/2	8
4	
8	
7	
6	
4 1/4	
7 1/2	
4	
5 1/4	
6 1/4	
7 1/2	
4 1/4	
6 3/4	
4 1/4	
132 1/4	

Average height 6 1/4 inches

G. & G.

108. Measurements in inches

+ 13 3/4
+ 14 1/4
+ 10 3/4
11 1/4
+ 13 1/2
10
10 1/2
+ 13 3/4
11 1/4
9 1/4
11 1/4
14 1/2
8 3/4
6 3/4
13 1/2
15
10 1/4
15 1/2
15 3/4
13 1/4
20 1/2
16
277 3/4
~~[illegible]~~
~~[illegible]~~
~~[illegible]~~

277 3/4
8 1/4
8 1/2
10 1/4
15 1/4
15
11 1/2
11 1/4
~~[illegible]~~
~~[illegible]~~
~~[illegible]~~
15 1/4
12
12 1/2
12 1/2
12
14
16 1/2
17 1/4
10 1/2
480 1/4

480 1/4
17 3/4
16 1/2
21
15 1/4
553

42)553(13
42
133
126
7)42
6

Average height
13 1/4 inches.

[illegible]

25.2330

Copied Nov. 30, 1909.

5/ The swamp blueberry does not thrive in a thoroughly decomposed leaf mold, such as has a neutral reaction.

It had been found in earlier experiments that certain soils composed in part of imperfectly rotted oak leaves, were very good for growing blueberries. On the supposition that the more thoroughly rotted this material was the better suited it would be for blueberry growing, a quantity of old leaf mold was secured for ~~the purpose~~ an experiment. The mold was black, mellow, and of fine texture. The mixed oak and maple leaves from which it was derived had been rotting for about five years, until all traces of leaf structure had disappeared. It was the same kind of black vegetable mold that forms in rich woods where Trilliums, spring beauty, and bloodroot delight

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to grow.

On February 20, 1909, twenty-five blueberry seedling were potted in 3-inch clay pots in a mixture consisting of eight parts, by bulk, of the leaf mold just described, one part clean sand, and one part clayey loam derived from rotted grass turf.

Fifty other plants were potted in the same manner except that in place of the mold was used a peat known from earlier experiments to be well suited to blueberry growing. The plants were kept in the greenhouse until warm weather when they were placed out doors. All were given the same treatment, a treatment favorable to good growth.

It had been expected that the plants in the leaf mold would show a vigorous growth, and it was hoped that the mold

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might prove even superior to the peat for blueberry soil mixtures. The experiment as it progressed, however, showed that such was not the case. The leaf mold proved to be not merely not a good soil for blueberries, but an extremely poor one, as the following particulars will show.

When the plants were potted they averaged about 2 1/2 ~~two and a half~~ inches in height. On May 29 the peat soil plants had an average height of 7 1/4 inches, while the leaf mold plants averaged 4 1/4. At this time the herbage of the leaf mold plants was decidedly purpled and yellowish, a coloration which it had taken on soon after the plants were potted and from which they never fully recovered. At the end of the season, after the leaves were shed, the peat soil plants averaged 13 1/4

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(over) inches in height, the leaf mold
? plants 7¾ inches. ¶ When these
plants were removed from their
original sand bed, to be trans-
planted to the 3-inch pots, such
of the original soil as clung to
their roots was not shaken off.
It is believed that the leaf mold
plants fed on this original soil in part in
making their new growth and
that without it they would have
shown still less increase in
height than they did. The peat
soil plants, moreover, were badly
in need of repotting, even in
early summer, and had they been
placed in larger pots the difference
in the growth of the plants in the two
soils would have been much greater
than it was.

That the influence of the leaf mold
was directly deleterious and that the

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On November 29, 1909, five average ~~representative~~ plants from each lot were cut off at the surface of the ground and weighed. The weight of the stems from the leaf mold plants was less than one fifth ~~that~~ from the plants in the good soil

poor growth of the blueberry plants in it was not due to the lack of some element that might have been furnished by the addition of a small amount of the good soil is shown by certain intermediate experiments. Along with the experiments described above were carried two others in which the soil mixture contained both peat and leaf mold. In the first, in which the proportions were peat 5, mold 3, sand 1, loam 1, the average height of the plants on May 29 was 6 inches, at the end of the season 12½ inches. In the second lot, in which the proportion was peat 3, mold 5, sand 1, loam 1, the average height on May 29 was 4½ inches, at the end of the season 11¾ inches. It will be observed that these two lots of plants are intermediate in their growth between the first two and that in all four lots ——— the poverty of

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growth is, roughly ~~but directly~~ proportional to the amount of leaf mold used in the soil.

That the weak growth of the plants in leaf mold was not caused by ~~due to~~ a compacting of the soil and a lack of aeration, due to too small a proportion of sand in the mixture, is shown by still another lot of twenty-five plants which were potted in a soil mixture ~~con-sisting in the~~ having the proportion mold 6, sand 3, loam 1. These plants averaged only 4 inches in height on May 29 and 6 1/4 inches at the end of the season. They grew even less, therefore, than the plants with only one part of sand and eight parts of mold.

The reason for the unexpected and remarkable deleterious quality

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of leaf mold shown by these ex-
periments is given on page
and further discussed on
page

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Nov. 30, 1909.

Culture 157. Fourteen plants now alive and growing. One of them now has three of the small, smooth, shining, flabellar-ciliate foliage leaves expanded. One of the earlier seedlings with white cotyledons has remained long stagnant, the cotyledons never having expanded. The growth of all the seedlings is slow after the cotyledons have expanded, the elaboration of starch with such a small chlorophyll surface evidently requiring much time and the growing energies of the plant being devoted chiefly to the development of an adequate root system.

Culture 198. No tips withered yet.

230 " " " "

231 " " " "

Culture 208. Last twig cutting dead. Only one root cutting with shoots above ground. Front four root cuttings taken up for examination and put back; all callused at one end and alive; first one with shoots started; fourth with shoots started and a new root formed.

Nov. 30, 1909.

Cattleya 133. The two plants of 133 in the cold house potted to-day from 4 inch pots into 6-inch pots, pure coarse sifted kalmia peat, the larger plant with crocks, both with a ~~good layer of~~ thick mass of fibrous kalmia peat at the bottom. Plunged in sand in the cold house.

Copied Dec. 1, 1909.

4. The swamp blueberry does not thrive in a heavy clay soil. Plate 3

In its natural geographic distribution the blueberry shows an aversion to clay soils. Its favorite situations are swamps, or sandy lands, or porous, often gravelly, loams.

When a blueberry plant grows upon a clay soil it is usually found that its finer feeding roots rest in a layer of half rotten vegetable matter overlying the clay. Often in such situations the dense covering of interwoven rootlets and dark peatlike soil may be ripped from the surface in a layer no thicker than a door mat and of much the same texture. The roots of the blueberry do not penetrate freely into the underlying clay.

In greenhouse cultures the blueberry shows the same aversion

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to clay soils.

Various series of blueberry seedlings were potted on May 26, 1908, in different soils in ordinary large drinking glasses. For one set of six plants a stiff clayey soil was used, such as is common in the neighborhood of Washington. The surface of the soil in the glass was mulched to the depth of nearly an inch with half rotten leaves. In another six glasses ~~were~~ set six similar plants in a peat soil, the surface mulched in the same way as the others.

In other ~~earlier~~ experiments with this soil, in clay pots, the growth of the plants had always been poor. The present experiment was no exception. But the feature of greatest interest was the behavior of the roots. Plate 3 (over) shows the

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from a photograph taken October 5,
1905,

root systems of typical plants in the two soils. In the clay almost no root development took place, and in the illustration no roots whatever are visible, ~~in the clay~~. The interrupted black lines in the clay are tunnels made by animals. In the moist leaf mulch on top of the clay, however, the plant developed its roots extensively. Some of the plants, probably because they were set too deeply in the clay when the potting was done, failed to send their roots up into the mulch, and such plants were much inferior in their growth to those that found the mulch. In the other glass is shown the normal ~~root~~ growth of a blueberry in a soil it likes.

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Dec. 1, 1909.

The temperature in the [illegible] [illegible] frame went just below 32° last night. There is still ice on the inside of the glass but the earth appears not to have been frozen.

The soil on the surface of the pots out doors froze last night. The sand between the pots did not freeze where the surface was dry and only slightly where the surface was moist.

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Dec. 1, 1909.

[at Indian Head, Northwest Territory]

"Ten bushes of huckleberries ~~[at Brandon, Manitoba]~~ were planted last spring".

A. Mackay, Canada Exper. Farms
Rep. 1893: 303. 1894.

"Ten bushes of huckleberries were received from Iowa and planted [at Brandon, Manitoba] in 1893, all started to grow, but this fall only three were alive, these are not promising and will probably succumb during the present winter".

S. A. Bedford, Canada Exper. Farms
Rep. 1894: 313. 1895.

Dec. 2, 1909

One lemon had 32 cc of juice.

Ten ounces = 320 cc., an ordinary lemonade glass.

Lemons juice is just about a normal solution of citric acid, a normal solution requiring 6.4% of citric acid. ~~and~~ A Mediterranean lemon having about 7% ~~and~~ citric acid, a California lemon about 6%

Ordinary lemonade is about a 10% normal acid solution.

Lemonade diluted ten times, making a 1% normal solution is only faintly acid to the taste.

BPI

Dec. 2, 1907,

Thermometer in the propagating frame went to 31° again last night. No ice on the glass at noon

Dec. 3, 1909

Soil is air-dried at room temperature.

Weigh out 10 grams of the soil, dry weight.

Add 200 cc of hot water, shake thoroughly, and allow to stand over night (boil to drive off carbonic acid)

In morning filter ~~and~~ off 100 cc. and titrate with a 5% or $\frac{1}{20}$ ~~[illegible]~~ normal solution of sodium hydrate, using phenolphthalein as an indicator.

Carbonic acid (CO_2)

Sodium hydrate ($NaOH$)

Breazeale. Dec. 3, 1907

1. cc. normal = 100 grams soil

1. cc $\frac{1}{20}$ normal = 5 soil

This is equivalent about of 250 lbs of CaO per acre ½ foot at 2,000,000 lbs.

Copied Dec. 4, 1908.

6. The swamp blueberry does not thrive in soils having a neutral or alkaline reaction, but for vigorous growth it requires an acid soil.

The means commonly used to ascertain whether a soil is acid or alkaline is the litmus test. The common method of applying the test is to moisten the soil thoroughly with some kind of pure water (water containing lime will not answer), make a slit with a clean knife blade, insert a strip of neutral litmus paper (which may be secured at a drug store), press the sides of the cut together, and allow the paper to remain for a few minutes to a few hours. If the paper turns pink acidity of the soil is indicated, if blue alkalinity. The depth of the color and the quickness of the change indicating in a rough way

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the strength of the acidity or al-
kalinity.

In using the method just described the color change is sometimes obscured through the smudging of the paper by the soil. To avoid this one may use a neat method developed by Mr. T. R. Robinson of this Department. In the bottom of a petrie dish (a small shallow flat-bottomed circular vessel of glass) is laid a strip of neutral litmus paper. Over this is placed a disk of filter paper of the same diameter as the dish. Upon the filter paper is laid the sample of soil to be tested, and enough distilled water is poured on to moisten the soil thoroughly. The cover of the petrie dish is then pressed on, flattening the soil

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against the filter paper. The soil moisture passes through the filter paper and coming into contact with the litmus paper the usual chemical reaction takes place. By turning the petrie dish bottom up the color of the litmus paper may be observed quite free from any muddying by the soil, for the filter paper does not allow the soil to come into direct contact with the litmus paper. While the petrie dish is lying bottom up, a freshly wetted piece of neutral litmus may be laid down alongside the other, but on the outside of the glass. This will enable the experimenter to make an exact observation of the degree of color change in the litmus paper within the

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dish. In delicate tests the soil 4
should be left in the dish over
night.

While one may become sufficiently expert in the use of the litmus test to form a fair judgment of the degree of alkalinity or acidity in a soil, an exact determination of this requires some different method. It was found that for the weak acids prevalent in the peat soils to the examination of which the present ~~our~~ experiments led, ~~as~~ the phenolphthalein test was the most satisfactory.

Phenolphthalein is a nearly colorless liquid, derived from coal tar. If a few drops of (over) ~~which added to an alkaline solution will turn the solution instantly pink. If the solution be acid the phenolphthalein will not change it to a pink color. The application of~~ added

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phenolphthalein be added to a solution, the solution if alkaline will turn instantly pink; if acid its color will not change.

The application of ~~This~~ this phenomenon to the determination of the degree of acidity of an acid solution, is as follows: A definite amount of the solution, usually 100 cubic centimeters is placed in a beaker, and into this is stirred drop by drop, by means of a special ~~[illegible]~~ ~~of~~ apparatus, a measured amount of some alkaline solution of known strength, commonly a, as it is known to chemists, one-twentieth normal solution of sodium hydrate. When a sufficient amount of the sodium hydrate solution has been dropped into the beaker the acidity of the acid solution becomes neutralized and it turns pink. A reading is made on the apparatus, showing the exact amount of the sodium hydrate solution used ~~required in effecting the~~ neutralization. ~~to neutralize the acidity of the acid solution.~~ From this reading is computed the degree of acidity [illegible] ~~the acid solution~~ expressed ~~[illegible]~~

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in percentages of a normal acid 6
solution. Now 100 cc. of a normal
acid solution would require for
its neutralization 100 cc. of a nor-
mal solution of sodium hydrate,
or 2000 cc. of a one-twentieth, or 5%, nor-
mal solution. In a test of one of the acid nu-
trient solutions used in the blue-
berry cultures, 18 cc. of a one-twen-
tieth normal solution was re-
quired to neutralize the acidity of
100 cc. of the acid solution. Since
18 cc. of a one-twentieth normal solu-
tion is the equivalent of one-twentieth
that amount, or .9 cc., of a normal
solution, the degree of acidity of this acid
solution is .9, that is, nine-tenths of one per
cent of a normal acid solution.
It requires .9 of one percent of a normal alkaline solution to neutralize it.
To express a ~~this~~ relation in another way,
~~nine-tenths of one cubic centimeter~~
~~of a normal acid solution diluted~~
~~to~~

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P 9 ms

a solution of 100 cc. consisting of 99.1 cc. of pure water and ~~to which had been added~~ .9 cc. of a normal acid solution would have the same acidity as the solution thus tested.

In applying this phenolphthalein test ~~to a solid body~~ to soils the same scale is used. Thus if a soil was described ~~[illegible]~~ ~~giving a test of 2~~ as having an acidity of 2., it would ~~mean~~ that by a certain method the acid extracted ~~[illegible]~~ from 100 grams of the soil, dry weight, would ~~[illegible]~~ be the same as that contained in 2 grams, ~~or~~ 2 cc., of a normal acid solution. The method of extraction followed for all the soil acidity tests given in this paper is ~~that described~~ as follows: (over)

~~It is one of the precautions of this ~~which~~ method of testing acidity to boil the solution, in order to drive off the carbonic acid, before the color test is made, for the presence or absence of carbonic acid is regarded as not ~~[illegible]~~ important ~~influence~~ in this connection. Certainly~~

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The soil ~~was~~ is first air-dried at an ordinary room temperature. Ten grams is then weighed out, shaken thoroughly with 200 cc. of hot water, and allowed to stand over night. In the morning 100 c . is filtered off and boiled to drive away any carbon dioxid present. The solution is then titrated with a 5% or $\frac{1}{20}$ normal solution of sodium hydrate, using phenolphthalein as an indicator. All the tests were made by Mr. J. F. Breazeale, of the Bureau of Chemistry, to whom the writer is greatly indebted for many courtesies and suggestions on the chemical side the experiments.

Page 9 next.

In considering the degree of acidity from the standpoint of the sense of taste it is convenient to remember that the juice of an ordinary lemon is very nearly a normal solution of citric acid (one). When the juice of a lemon is diluted to about ten times its original bulk, as in a large drinking glass, one has approximately a 10% normal acid solution. When diluted to 100 times, making about a 1% normal solution, there remains only a faint taste of acidity. The acidity of water after standing long in contact with peat in a barrel sometimes reached .5% normal. Bog water, or peat water, is sometimes appreciably acid ~~to the taste~~.

Returning now to a consideration of the statement that the swamp

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No.

The juice of a Mediterranean lemon averages ~~is~~ about 7% citric acid, of a California lemon about 6%. A normal solution of citric acid is 6.4%

10a

an experiment in this direction may first be cited. ~~On February 17, 1911,~~ The experiment was made ~~began~~ with twelve small glass pots, each containing a ~~small~~ blueberry seedling. The soil in the pots was a clean river sand. The plants had been in these pots for eight weeks, watered with tap water. The amount of nourishment they had received from the sand ~~soil~~ and water was very small, and when transplanted into the pots ~~the~~ all the soil of the original seed bed had been carefully ~~shaken~~ removed from the roots. Nevertheless all the plants had made extensive, even luxuriant, root growth. The tops, however, had made ~~no~~ ~~scarcely~~ no growth. There had been ~~one~~ complete stagnation or withering of the youngest leaf rudiments, and the mature ~~old~~ leaves became and remained deeply bur-

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pled.

On February 17, 1909, eight weeks after the plants had been potted in the sand, as already stated, five of the pots began to be watered with an acid nutrient solution made up, in accordance with the advice of Dr. Karl F. Kellerman, as follows:

Potassium nitrate (KNO_3)	1.0 gram
Magnesium sulphate ($MgSO_4$)	0.4 "
Calcium sulphate ($CaSO_4$)	0.5 "
? Calcium monophosphate (Ca	0.5 "
Sodium chloride ($NaCl$)	0.5 "
? Ferric chloride (Fe	trace
Water	1000. cc.

When first prepared this solution gave an acidity test of 1.2% normal. after standing for several weeks its acidity was still .9% normal.

Five other plants from the same twelve were watered with an alkaline nutritive solution of the following composition:

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Potassium nitrate (KNO_3) 1.0 gram
Magnesium sulphate ($MgSO_4$) 0.4 "
Calcium sulphate ($CaSO_4$) 0.5 "
Potassium diphosphate(0.5 " ?
Sodium chloride ($NaCl$) 0.5 "
Ferric chloride (Fe trace
Water 1000 cc.

By the addition of a sufficient quantity of sodium hydrate the reaction of this solution was made alkaline to the degree of .6 % normal; at the end of several weeks it was still alkaline to the extent of .48% normal.

Two of the twelve plants were left as checks, being still watered with tap water.

On March 25, 36 days after the watering ~~with the two nutrient solution began, the two~~ began, the five plants fed with the acid nutrient solution were restored to a nearly normal green color, and

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all had begun to put out healthy new growth. The two check plants watered with tap water were still red-purple and stagnant. Of the five plants watered with the alkaline nutrient solution, three were stagnant and somewhat purplish, one was dying, and one was dead.

Plate 7, from photographs taken on April 15, 1909, shows a typical stagnant plant that had been watered with the alkaline solution, and a ~~a~~ typical plant watered with the acid solution, which had begun to make new growth from the summit of the old stem and was pushing out a vigorous new shoot from the base. The experiment was ~~the~~ terminated ~~continued~~ not long afterward ~~this time~~, but there was every prospect that had it been continued the acid-fed plants would have made

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growth comparable with that 10a

?? shown in Plate , fig , and

?? Plate , fig .

Looking now toward the acidity or alkalinity of the other cultures thus far cited ~~described~~ [Proceed as on page 10]

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blueberry does not thrive in a
[insert pages 10a to 10z]
neutral or alkaline soil, it may
be stated that the rich garden
6) soil described on page , which
was so remarkably deleterious to
blueberry seedlings was
alkaline. The rose cut-
tings and the alfalfa, which grew
so well in that mixture, much pre-
fer a somewhat alkaline soil.
Indeed alfalfa cannot be grown
with any degree of success in
any soil except one with an alka-
line reaction. When grown in
the humid eastern United States
alfalfa is rarely successful, ex-
cept on calcareous soils, unless
the natural acidity of the soil
has been neutralized by suita-
ble applications of lime.
The limed soil, deleterious to

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~~an experiment in this direction may~~
~~first be cited.~~

blueberry plants, described on page
(8e) gave a neutral reaction with
phenolphthalein.

The heavy clay soil described
(9) on page , in which blue-
berry plants made very little
growth, was neutral.

The thoroughly decomposed leaf
(10) mold described on page ,
which was shown by experiment
to be markedly deleterious to the
blueberry, was distinctly alkaline.
A chemical analysis of this mold dis-
closed ~~the~~ reason for its alka-
linity. It contained 2.86% of
calcium oxid, the equivalent
? of about % of airslaked lime.

~~All but one of the deleterious
soils in the experiments so
far described were either neutral
or alkaline. The exception was~~

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The good blueberry soils in all the experiments were acid, the acidity at times of active growth varying from 2.5% normal down to .3%

The natural distribution of the blueberries and their relatives indicates their close adherence to acid soils. They occur in abundance throughout the sandy coastal plain of the Atlantic seaboard, ~~the soil of which is generally acid except where modified by cultivation. They occur in abundance in the cool humid mountain sandy lands of New England~~ the prevailingly acid character of which is now well known through the classical experiments of Dr. H. J. Wheeler of the Rhode Island Agricultural Experiment Station. They occur generally through the cool humid hill ~~mountain~~ lands of New England, the acidity of which is notorious. They occur in sandy

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pine barrens and peat bogs throughout 13
the eastern United States, both of which are acid. They are
absent, on the contrary, from limestone soils, ~~from well drained clay soils of all kinds~~ from rich
bottom lands and rich woods,
where the soils are neutral or
alkaline. ~~and~~ In the lower elevations of the whole subarid
West, where acid soils are almost
unknown, these plants do not
occur. Within reach of the ~~coast~~
fogs and heavy rainfall of the Pacific coast, ~~or~~
or on the higher mountains of the interior, where
conditions favor the development
of acid soils, they occur again
in characteristic abundance.

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7. The favorite type of acid soil for the swamp blueberry is peat.

Although the swamp blueberry sometimes grows on upland soils its typical habitat, as its name implies, is in swamps or bogs. The cranberry, it is well known, is cultivated almost exclusively in bogs. In clearing bog land preparatory to the planting of cranberries one of the necessary precautions is to remove all roots of the swamp blueberry. For if the roots are allowed to remain in the ground they send up vigorous shoots and these unless pulled up develop ~~later~~ into robust plants which occupy the ground, to the great injury of the cranberries. Large, healthy, and productive bushes of the swamp blueberry are frequent, almost characteristic, inhabitants of the uncultivated borders of cranberry bogs.

Peat bogs, in the conception of the geologist, are incipient coal

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beds. The transformation of peat into
coal occupies very long periods, per-
haps some millions of years.
Peat is made up chiefly of vegetable
matter, the dead leaves, stems, and roots
of bog plants, which are only
partially decayed. Their full de-
cay is prevented, primarily, ~~as a primary~~
~~reason~~ by the presence of water,
which keeps away the oxygen of the air.
~~Under this condition~~ The bacteria,
fungi, and other minute organisms
by which ordinary decomposition progresses
cannot live under this condition,
and decay is suspended. The acids
developed by this vegetable matter
in the early stages of its decom-
position are also destructive to
some of the organisms of decay, es-
pecially bacteria. These acids act
therefore as preservatives and
greatly assist in preventing decom-
position. So effective are these con-

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ditions of acidity and lack of oxygen, assisted in northern latitudes by low temperature, which is also inimical to the organisms of decay, that bogs sometimes preserve for thousands of years the most delicate structures of ferns and mosses.

Tests have been made of the acidity of typical peat bogs in New England, where swamp blueberries were growing. These peats were always found to be acid and the degree of acidity was within the range found satisfactory for blueberry plants in pot cultures.

The reason why peat is a particularly satisfactory type of acid soil for blueberries is, apparently, because the acidity of peat is of a mild type, yet constantly maintained.

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Not all peats are acid. About the larger, alkaline, but not distinctively alkaline, springs of our southwestern desert region are deep deposits of pretty well decayed vegetable matter, that must be classed as peat. The characteristic vegetation growing on these peats, where the alkalinity is not too great, is tule (Scirpus occidentalis and Scirpus olneyi). The soil of one of the great tule swamps of the west, Lower Klamath Lake in southern Oregon, which contains thick beds of peat formed chiefly from Scirpus occidentalis, has been examined recently by agricultural investigators and found to be distinctly alkaline.

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The peat formed about marl ponds in the eastern United States is also, in all probability, alkaline unless formed at a sufficient distance from the lime-laden water to be beyond the reach of its acid-neutralizing influence.

Such alkaline peats, while not yet actually tried, are believed from other experiments to be quite useless for growing blueberries. Certain it is that neither blueberries nor any of their immediate relatives are found on these soils in a wild state. In the eastern United States, however, such alkaline peats are comparatively rare, and the use of the word peat conveys ordinarily the idea of acidity. All the soils used by gardeners under the name of peat are acid.

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8. Peat suitable for the swamp blue-berry may be found either in bogs or on the surface of ~~the~~ ground in sandy oak or pine woods.

In the vicinity of Washington deposits of bog peat are few and of limited extent, and the peat is thin. As a matter of fact no bog peat of local origin is used by the gardeners and florists of Washington. For growing orchids, ferns, azaleas, and other peat-loving plants, either peat shipped from New Jersey is used, or a local product sometimes known as "Maryland peat". This material is of very great interest in connection with these blue-berry experiments, for it was the principal ingredient in a majority of the successful soil mixtures used, ~~Maryland peat~~ is not a bog peat at all, and since it it is desirable that the reader have a comprehensive idea of its character.

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Maryland peat, as brought to the greenhouses of the Department of Agriculture, consists of dark brown turfs or mats, two to four inches thick, made up of partially decomposed leaves interlaced with fine roots. It is found in thickets of laurel, Kalmia latifolia, where the leaves of this shrub usually mixed with those of various species of oak, have lodged year after year and the accumulated layers have become partially decayed.

The nature of the deposit may be easily comprehended by means of the accompanying illustrations. The photographs from which the illustrations were made were secured through the courtesy and skill of Mr. G. N. Collins of the Department of Agriculture. The photographs were made in the month of April, 1908, in a laurel thicket at Lanham,

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Maryland. After ~~the~~ one photograph was made, the layer of leaves represented by it was removed and another photograph was taken showing the layer immediately underneath.

In Plate 8 is shown the top layer of the leaf deposit, as it appeared in April, 1908, consisting of oak leaves of various species, which fell to the ground in the autumn of 1907. The next underlying layer is shown in Plate 9. The laurel leaves are those that fell in the summer of 1907. Laurel being an evergreen its leaves are not shed in the autumn like those of the oaks. They remain on the bush until the new leaves of the following spring are fully developed and then the old leaves begin to fall. It is this circumstance of the fall of the oak and laurel leaves at different periods of the year which enables one to recognize the (over)

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different layers ——— and know
their exact age.

The third layer, shown in Plate 10,
consists of oak leaves ~~of~~ the autumn of 1906.
This layer was moist and decompo-
sition was well started. The presence of fun-
gus growth is evident to the eye, as is
also the excrement of various small
animals. ~~The part played by~~ The larvae
of insects and ~~the~~ thousand-legged
worms in hastening the decomposition
of leaves must play a very important part, under some conditions,
The fourth layer, Plate 11, consisting of
laurel leaves shed in the summer
of 1906, is in about the same con-
dition as the preceding. In the fifth
illustration, Plate 12, ~~showing~~ the leaves of 1905
but with the ~~line of demarkation be-~~
~~tween laurel and oak not read-~~
ily layer of oak leaves not readily
separable from the laurel, the
leaves crumble readily and de-
composition has so far progressed
that a few oak rootlets are found spread
out between the flattened leaves.

Plate 13 shows the rotted leaf layers of 1904 interlaced with the rootlets of laurel and oak. It is this root-bearing layer, two inches or more in thickness, of which Maryland peat is composed. The lower portions of it ~~have~~ reached a somewhat greater degree of decomposition than is here shown.

~~One who has observed the rotting of leaves~~ In a rich woods of the trillium-producing type, such as a fertile sugar maple forest, ~~in fertile soil,~~ one may observe that the leaves in rotting seldom ~~stay retain their form on the ground~~ longer than two years and that the line of demarkation between the thin leaf litter of the forest and the underlying woods mold is sharp and clear.

In ~~the sugar maple woods~~ ~~this case~~ the decomposition ~~of the decomposition~~ of the leaves is

rapid. In the Maryland, or kalmia, 6
peat, as it may be called with more exactness, the decomposition is slow. The cause of this difference in the rate of decomposition is the difference of acidity in the two cases, and this in turn is dependent on the nature of the leaves and ~~the nature~~ of the underlying soil, particularly whether the soil is acid or alkaline. A slight alkalinity in a soil greatly favors the decomposition of the leaves overlying it (or is).

~~The writer regards~~ These upland leaf deposits, in which decomposition is retarded for many years, ~~by acidity through the killing of the microorganisms of decay by the acids~~ the writer regards as ~~peaty~~ essentially peats, and to distinguish them from bog peats he would call them upland peats. An upland peat may be described as

7. For vigorous growth the swamp blueberry requires an acid soil.

an acidity as strong as that shown to occur in newly fallen oak leaves (see page) cannot help having a pronounced effect in maintaining the acidity of the lower leaf layers, for it must be remembered that these acids are soluble in rainwater and are therefore continually leaching down from the upper through the lower layers of rotting leaves.

a nonpaludose deposit of organic matter, chiefly leaves, in a condition of suspended and imperfect decomposition and still showing its original leaf structure, the suspension of decomposition being due to the development and maintainence of an acid condition which is inimical to the growth of the microorganisms of decay.

(over) ~~The~~ Kalmia peat should be piled up and rotted for several months before blueberries are transplanted into it. An experience of the writer which emphasizes the need of this treatment is given on page . If stacked as soon as it is dug it ~~will~~ usually retains sufficient moisture to carry the rotting forward evenly if ~~water~~ the stack is ~~not loose or~~ under cover.

20?

Kalmia peat has proved to be

6. The swamp blueberry does not thrive in soils having an al-kaline reaction.

The use of the "leaf mold", sometimes applied to this upland peat, should be restricted, it seems to the writer, to the advanced stages in the decomposition of leaves, in which leaf structure has disappeared.

a highly successful soil for growing blueberries. It has been tried both pure and in many mixtures, as will be described in the paragraphs beginning on
20) page.

An upland peat formed of the leaves of scrub pine (*Pinus virginiana*) has also been tried for blueberry seedlings. They grow well in it.

Oak leaves it is believed, rotted for ~~about~~ one or two years would make a good blueberry soil. In the Arlington National Cemetery is a ravine in which large quantities of leaves, chiefly oak, have been dumped for many years. Samples taken there in late November, 1909, ~~and tested for acidity~~ show an acidity, in the case of freshly fallen leaves, of 40% normal; in leaves approximately one year old, 6%; ~~in leaves about two years old, 2%.~~

and in leaves about two years old .2%.

A condition of great interest was found in one of these piles of leaf mold ~~in this same~~ which was several ~~three~~ years old. It was mellow and black, and the evidences of leaf structure had disappeared. When submitted to the phenolphthalein test it proved to be alkaline, and upon chemical examination it was found to contain 3.55% of lime (CaO). In this case decomposition had progressed so far, and the acidity had dropped so low, that the lime remaining constant in the leaves in amount, neutralized the remaining acidity. ~~and~~ the material then becoming alkaline had proceeded to decompose with greater rapidity, until a real mold had been formed.

10

The condition here observed is doubtless the same as that which occurs in the drained bog, or so-called "muck", lands of Michigan. When first ploughed they will grow only certain acid-resistant crops, such as

but later as their acidity disappears they ~~come~~ to attain ~~the~~ a very ~~high~~ degree ~~type~~ of fertility. It is probably a phenomenon of similar character which is taking place in the drained swamp lands of the lower Sacramento River in California, where the ~~alkalinity of the~~ soil, which is already in a state of remarkable fertility, is becoming increasingly alkaline.

~~The writer may here~~
~~In further digression may be permitted here, to~~
Here the writer may allude to another phenomenon that of the occurrence of certain plants, such as the swamp blueberry and

the purple lady's slipper (*Cypripedium acaule*) and the swamp honeysuckle (*Azalea nudiflora*), in two kinds of situation, one a peat bog, the other a sandy, well drained, and often dry upland. The favorite explanation of this phenomenon among botanists is that these plants are naturally adapted to the dry situation and that in the bog they find a situation of "physiological dryness", or vice versa.

~~Certainly the writer's experiments show that~~ This ~~explanation~~ ~~certainly will not answer for the blueberry.~~ Its occurrence in these two habitats is dependent on the acidity of both situations. No amount of dryness ~~acidity~~ will make a blueberry ~~grow~~ flourish in an upland soil if that soil is not acid.

The writer's experiments have shown that

No 9

While the writer does not question the physiological dryness of a peat bog the explanation that a bog plant finds an upland situation congenial because it is dry certainly will not answer for the blueberry.

Desert Botanical Laboratory
of the
Carnegie Institution

BPI

Dec. 7, 1918

~~Culture~~ 194. Fourteen cuttings show some or all the tissue above ground dead.

Culture 223. Two 2nd cuttings examined, both with a small ring of callus at one end, replaced.

Culture 208. Five more root cuttings show shoots just coming through the sand, making six that are either ... The oldest is now 17 mm high.

Samples of soils for ~~nitrification tests~~ taken by Kellerman.

Kellerman's [illegible] from the pile

— — sifted about Dec. 2, 1918

[illegible] sifted, [illegible] a few days ago.

BPI

'Next.' Dec. 7, 1909

Culture 239 Half a flat. Soil ~~[illegible]~~ put in flat to-day, pure kalmia peat coarsely sifted.

Culture 240. Half a flat. Soil put in flat to-day Kalmia peat, coarsely sifted 9 parts, manure 1 part.

Budded plants in greenhouse. The inserted bud has started in none, though four have persisted in trying to throw out shoots from buds belonging to the stock. These four are 185, 186, 17, and 70. One more, 182 is dead. Two, 21 and 8, are alive but have pushed no buds on the stock.

Vaccinium ovatum. All the plants have grown well in their 3-inch pots plunged, the tallest 15 cm high, the least 5 cm. The house they are in is too shaded and too moist, perhaps too warm. Some of the taller ~~have~~ have fallen down and are sending new shoots from the base. A mildew has appeared on some.

Dec. 7, 1909

Kinsler. From Columbia to Camden, in the long leaf pine country, fine huckleberries are found along the branches. Best one about 3 feet high. Fruit in June. Big bunches. Blue berry. Very productive.
Columbia an excellent place to

Dec. 8, 1909.

Experiment. Set out in a deep glass vessel, and against the side of the glass, in ~~loose~~ sand (perhaps burnt) watered with peat water (or in sphagnum with peat), an old blueberry plant, the lower part of the aquarium containing standing water rising half way up the old root ball of the plant. Hold the water at this level till ~~the~~ root growth ~~has [illegible]~~ is well under way, and then let the water level gradually settle. The object of the experiment is to ascertain whether new root growth will form beneath the water surface, and whether roots that have remained long beneath the water surface will so retain their vitality that when they emerge they will ~~still~~ put forth vigorous root growth.

A. 14 Copied Dec. 8, 1908.

9. For active growth the swamp blueberry requires a well aerated soil. Conversely, the swamp blueberry does not continue in active growth in a soil saturated with water.

In its natural distribution the swamp blueberry does not grow in the lower, wetter type of bog. In a typical leatherleaf (<u>Cassandra calyculata</u>) bog, for example, the swamp blueberry is found either about the margin of the bog or on hummocks. In both these situations ~~cases~~ most of the roots of the blueberry bushes stand above the summer level of the water in the bog. When ~~the general surface of~~ a bog has been built up by the growth of ~~its~~ vegetation and the accumulation of its debris, until ~~its~~ the surface is ~~sufficiently~~ above ~~its~~ the summer water level, the swamp blueberry will occur generally over ~~its surface~~ the bog.

An examination ~~of the roots~~ of blueberry plants occurring on hummocks and bog margins has shown that such roots as extend beneath ~~below~~ the permanent summer water level bear few feeding rootlets or none at all.

In one experiment ~~in which~~ it was attempted to grow blueberry seedlings in ~~~~ water cultures containing various dissolved nutrients. ~~solutions~~ It was found that ~~the roots the roots when submerged~~ the roots made no new growth, ~~and~~ that the new leaves were few and small, and that the general health of the plants was not good, whatever the character of the nutrient substances in the solutions. It was frequently observed also in the various soil cultures, particularly those in undrained glass pots, that

the continued saturation of the soil with water reduced the root growth and enfeebled the whole plant. Continued excessive watering of potted blueberry plants was found ~~generally~~ always injurious.

The observations just recorded must not be misunderstood to mean that submergence of the roots is always injurious to the swamp blueberry. In winter and early spring the water level of bogs containing blueberries ~~is~~ often remains high enough for several months to completely submerge the whole root system of the plants. On the

Sch. 1 lower end of the cranberry bog near Wareham, Mass., are some native bushes of the swamp blueberry ~~bushes~~ the roots of which have been submerged in three feet of water

~~9. Peat suitable for the swamp blueberry may be found either in peat bogs, or on the surface of the ground in sandy oak or pine woods.~~

from December to May each year for about twenty years. These bushes when observed in September, 1909, gave every evidence of vigor. Their twig growth was of good length and thickness, their foliage was dense and of a healthy color, their flowering buds for the next year were fairly numerous, and the bushes were said to be as productive of fruit as neighboring bushes on higher ground.

It would appear from these facts that, while submergence during the dormant period is not injurious to the swamp blueberry, its roots during the active growing period must be above the water level and well aerated.

~~8. The favorite type of acid soil for the swamp blueberry is peat.~~

Slip 6 11.

Addition to Statement 6

Copied Dec. 9 [illegible]

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The consideration of this statement requires first an understanding of the means used to determine whether a soil is acid or alkaline. The simplest means

Slips p. 11a

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A drinking glass with a flat bottom makes a fair substitute for the petri dish.

slip 11 b

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A soil would have an acidity of 100% when an extract of 100 grams of the soil, dry weight, made by a certain method in 100 cc. of water would give a normal acid solution. If a soil were described as having an acidity of 2, or 2% normal, it would mean that the extract of 100 grams of it in 100 cc. of water would be a 2% normal acid solution, that is, that 100 cc of the solution would contain 2 cc. of a normal acid solution.

Slide 11c

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The expression "normal solution" used in this paper, it must be understood, is the normal solution of chemists, not of ~~physiologists~~ surgeons. Surgeons use the expression "normal salt solution" to describe a certain weak solution of common salt in water, ~~which has~~ ~~having~~ which has the same strength as the ordinary solution of salt in the blood. A normal solution ~~of chemists~~ in chemistry is a solution of certain fixed strength based on the molecular weight of the substance under consideration. Normal solutions of the various acids have the same ~~strength~~ degree of acidity. Normal solutions of ~~alkalies~~ alkaline substances are equal to each other in alkalinity. A measured amount of a normal solution of an acid (over)

will exactly neutralize an equal amount of a normal so-
lution of an alkaline substance.

Dec. 9, 1909.

Experiment. Mr. Collins suggests that in order to establish lack of aeration as the cause of the failure of a blueberry plant to grow in an acid nutrient solution, one of these liquid mixtures should be connected with a laboratory air blast in such a way that a continuous trickle of air will pass through the solution.

This should be tried.

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Dec 9 1909.

Temperature in propagating frame went down last night to Deg. F. 21° ~~12~~. At half past eleven A.M. it was still below freezing. The sphagnum tops were frozen as was the top of the soil in the Epigaea pot, which was close to the glass. Out doors ~~both~~ the soil in the pots was frozen as well as the surface of the sphagnum sand.

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Dec. 10, 1909.

Propagating frames went down to 23° last night surface soil in all pots froze, and slight ice formation here and there on the surface of the beds.

Culture 199. Eighteen cuttings in the bed are badly or partly blackened.

Culture 236. One more root cutting has a shoot out of the ground to-day.

Culture 224. Three root cuttings examined to-day, all alive but with no callus or other sign of starting. Cuttings about ¼ inch in diameter.

Culture 223. Three root cuttings examined, all callused at one end, one with a fragmentary callus at the other end. These cuttings are about ¼ inch in diameter.

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p. 5 Copied Dec. 10, 1909.

10. Aeration conditions satisfactory for blueberries are prevalent in sandy soils.

In the experiment described on page (14) it was found that blueberry seedlings having their roots suspended in nutrient solutions even though the solutions were suitably acidulated failed to make a normal growth. This failure was ascribed to lack of aeration. In another experiment described on pages (11c) to (11e) it was shown that a similar nutrient solution when used to water a blueberry plant potted in sand produced a normal growth of both roots and stems. The sand furnished no appreciable nourishment and the only essential difference in the two cases was the abundant root aeration afforded by the sand culture.

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Sand is therefore regarded as having been shown experimentally to be a suitable aerating medium.

In their wild state blueberries are especially prevalent on the sandy soils of the Atlantic coastal plain as well as on sandy plains and pine barrens in the interior. The drainage of such soils is good and their aeration is excellent.

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p. 15 Copied Dec. 11, 1969

In all the experiments in which blueberry seedlings were grown in sand cultures suitably acidulated the root growth was good, even though very little nourishment was given the plant, and when fed with a weakly acid nutrient solution or with pond water the sand-potted plants always made a luxuriant root growth.

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Dec. 13/1911

Culture 50. Three plants taken from window sill and plunged in sand out doors.

Culture 145. Taken from window sill and placed out doors, cold frame.

Epigaea. Pot from propagating frame, frozen, placed in greenhouse no. 1.

Culture 113. Glass pot plunged in sand in large pot and put back on window sill.

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[illegible] p. 16. Copied Dec. 14, 1909.

11. Aeration conditions satisfactory for the swamp blueberry are found in drained fibrous peat.

Kalmia peat when ~~in~~ the original turfs or mats is full of small roots of ~~oaks~~, kalmia, and other plants. In that condition it is remarkably porous and well aerated. ~~S~~ Pieces of these turfs were used with great success in the bottoms of pots, in place of crocks, to afford drainage. For a potting soil, however, kalmia peat cannot easily be used until the soil has been shaken from the mass of roots or has been rubbed through a screen. Even in that condition the presence of fragments of leaves and rootlets makes the whole mass porous.

A pot containing ~~pure kalmia~~ peat prepared by ~~such rubbing~~ .... often remains moist yet well aerated

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for days at a time without watering. This moisture condition is due to two remarkable properties of peat, its high capacity for holding moisture and the tenacity with which it clings to it. #Kalmia peat taken from the interior of a stack after it has remained several months under cover ordinarily contains 100% of water, computed on the dry weight of the peat. Even with this very high water content a peat soil is in a beautiful condition of tilth, mellow, well aerated, and to the sight and touch only moderately moist. Ordinary loam in a similar condition contains only about ~~20~~ 18 per cent of water, and sand about ~~20~~ 3 per cent. When saturated with water the moisture content of kalmia peat is about

The ability of peat to retain its

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moisture depends in part on the gradual drying of the superficial layers and the consequent formation of a mulch, but more particularly is it dependent on a certain natural physical affinity ~~fertility~~ that peat possesses for water. (over) ~~or a high~~

~~degree, be means~~

~~This may be described as the ability to withstand drying.~~ A test of kalmia peat made by Mr. Lyman J. Briggs of the ~~the~~ Department of Agriculture, the originator of this method of measurement, showed a moisture equivalent of 142% as compared with about 30% for clay ~~clay~~, 18% for loam, and 2 to 4% for sand.

From what has been said it is evident that fibrous kalmia peat has a texture that admits of ample aeration while at the same time holding abundant

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The comparative strength of this water-holding power in different soils may be tested by subjecting them ~~soils~~ to a powerful centrifugal force, ~~to~~ ~~the load being~~ which tends to throw the moisture out of the soil. The standard centrifugal force used ~~as~~ is ~~1000~~ a thousand times the force of gravity. The percentage of moisture remaining in the soil after this treatment is known as the moisture equivalent of that soil.

moisture for the supporting of plant growth. 4

Endowment

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Dec. 14, 1909

Culture 221. Dendrium seeds are up to-day, about half a dozen of them.

Culture 241. Half a flat. Soil put in flat yesterday, kalmia peat 9, sand 1.

Culture 242. Half a flat. Soil put in flat yesterday, kalmia peat 8, sand 1, manure 1.

Culture 243. Half a flat. Soil put in flat to-day, kalmia peat 8, loam 1, sand 1.

Culture 244. Half a flat. Soil put in flat to-day, kalmia peat 7, loam 1, sand 1, manure 1.

Culture 209. Taken from 40-60 house to house no. 1, about 60° F. night.

Culture [illegible]. Watered with fish water the front part of the two rows in the [illegible] bed. This row contains 5 plants about [illegible] pounds.

Culture Nov 16, 1917

239 Twenty-eight plants from Culture 115 ~~trans~~planted into the field to-day by Miss Burns. Seed bed soil not removed, ~~but only a slight amount~~ ~~went in~~, from the roots of the seedlings, ~~these being~~ picked it and [illegible] the field.

Culture 240 [Same]

Culture 241 [Same]

242 [Same]

243 [Same]

244 [Same]

Dec. 16, 1907

Culture 167. Brought from cold house (40° at night) into house no. 1 to-day ~~[illegible]~~ 65° at night ~~[illegible] at night~~

Culture 201 ~~[illegible]~~ [Same]

" 210 "

" 211 "

Culture 118. All the remaining cuttings taken from the bed and examined or [illegible]. All were partially or completely dead, except one, the [illegible] living from the bottom upward. Only one had made any rootlets, and that one was dead at the base, including the rootlets.

Culture 222 All these root cuttings taken up for examination. All living and callused at one or both ends. None rooted. One with a shoot started. Replaced.

Culture 223. All six cuttings taken up for examination. All alive and callused, none rooted. All replaced.

Culture 208. Oldest and tallest sprouted root cutting taken up for examination. Heavy callus at one end none at other. [illegible] beginning, not roots.

6.17. Copied Dec. 15, 1909.

12. Aeration conditions satisfac-
tory for the swamp blueberry are
found in masses of live, moist,
but not submerged sphagnum.

~~When growing~~ In some swamps in ~~which~~
the water level remains perma-
nently above the general surface of
the ground. When growing in such situations the swamp blueberry
~~stands~~ upon hummocks the sum-
mits of which rise above the water
during the growing season. ~~It~~
Unless the water level is ~~~~ extremely
variable or the ground is densely shaded, these hummocks are
usually ~~covered~~ with a cushion ~~~~ of
live sphagnum moss. It is a pe-
culiarity of this ~~sort of~~ moss that
it absorbs water with great avid-
ity. If one end of a partially ~~dry~~ branch of
sphagnum is ~~be~~ brought into con-
tact with a little ~~~~ water, the
whole branch becomes wet almost

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Sphagnum [illegible], highest development in cedar swamps

instantaneously. The water rushes along with marvelous rapidity ~~both~~ through the cells of the plant and especially through the interstices between the overlapping leaves. The white air spaces between the half dry leaves flash out of existence one after the other like candle flames in a gust of wind.

Sphagnum is one of the most absorbent substances known. If the lower part of a cushion of sphagnum is in contact with free water the ~~a sufficient amount of the~~ fluid is conveyed from stem to branch and from plant to plant in sufficient amount to render the whole mass as wet as a sponge. When one squeezes a handful of such moss ~~from~~ taken a foot or more above the source of moisture a stream of water

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runs out. ~~may be ignored.~~ The cushion of sphagnum tends to build itself up, by the gradual process of growth and decay, to the maximum height to which ~~the mass~~ it can convey the large amount of water required for ~~the~~ its growth, ~~of the sphagnum~~

The innumerable air spaces between the sphagnum plants and among their branches furnish ample aeration. ~~The~~

~~[illegible]~~ If the sphagnum cushion on a blueberry hummock is examined ~~[illegible]~~ the whole mass will be found interlaced with the spinning rootlets of the blueberry. ~~the level of the~~ underlying ~~soil.~~ ~~E~~ ~~for above the~~ ~~[illegible]~~ The conditions of permanent ~~[illegible]~~ moisture and thorough aeration found in these sphagnum cushions seem to be almost ideal for the development of blueberry roots.

It must not be assumed that the vigorous growth of blueberry roots in sphagnum is due to any high

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nutritive quality of the sphagnum 4
itself. Such a conclusion would
be erroneous. As shown by
chemical analysis sphagnum ~~is~~
contains little ~~very low in~~ plant food. ~~substance.~~
When set out in ~~two~~ sphagnum
and watered with tap water
blueberry plants remain healthy but
they do not grow luxuriantly as
when set out in peat. From
experiments with the growing of blue-
berries in ~~pure~~ sand watered with
peat water it is known that such
water ~~is in itself able to~~ furnishes
the food materials necessary
for vigorous growth. It is reason-
able to conclude therefore that the
chief nourishment of a blueberry
plant growing on a pure sphagnum
hummock comes from the bog
water sucked up by the sphag-
num, and not from the sphagnum

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itself.

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Culture 239. Height of plants as follows: Dec 15, 918

A 1 15 mm.	B 1 10 mm	C 1 12 mm.
A 2 25	B 2 15	C 2 15
A 3 25	B 3 13	C 3 15
A 4 15	B 4 10	C 4 13

D 1 15 mm.	E 1 10 mm.	F 1 15 mm.	G 1 13 mm.
D 2 15	E 2 25	F 2 17	G 2 18
D 3 20	E 3 17	F 3 15	G 3 17
D 4 17	E 4 12	F 4 10	G 4 10

Culture 240 Height of plants as follows:

A 1 13 mm.	B 1 17 mm.	C 1 15 mm.	D 1 15 mm.
A 2 22	B 2 16	C 2 20	D 2 18
A 3 20	B 3 25	C 3 17	D 3 15
A 4 15	B 4 15	C 4 15	D 4 13

E 1 15 mm.	F 1 26 mm.	G 1 7 mm.
E 2 26	F 2 22	G 2 15
E 3 20	F 3 22	G 3 18
E 4 8	F 4 13	G 4 13

Culture 241 Height of plants as follows:

A 1 10 mm.	B 1 10 mm	C 1 10 mm.	D 1 13 mm.
A 2 18	B 2 17	C 2 15	D 2 14
A 3 17	B 3 20	C 3 11	D 3 15
A 4 13	B 4 8	C 4 8	D 4 13

E 1 15 mm.	F 1 8 mm.	G 1 12 mm.
E 2 16	F 2 13	G 2 13
E 3 14	F 3 10	G 3 17
E 4 10	F 4 12	G 4 13

Culture 242, Height of plants as follows: Dec. 15, 1909

A1 20 mm.	B1 18 mm.	C1 13 mm.	D1 17 mm.
A2 18	B2 28	C2 15	D2 23
A3 22	B3 18	C3 27	D3 17
A4 17	B4 13	C4 15	D4 10

E1 15 mm.	F1 15 mm.	G1 13 mm.
E2 24	F2 17	G2 17
E3 20	F3 15	G3 17
E4 12	F4 18	G4 12

Culture 243, Height of plants as follows:

A1 20 mm.	B1 13 mm.	C1 15 mm.	D1 10 mm.
A2 20	B2 10	C2 10	D2 14
A3 18	B3 10	C3 10	D3 13
A4 15	B4 12	C4 10	D4 8

E1 13 mm.	F1 15 mm.	G1 17 mm.
E2 20	F2 15	G2 20
E3 25	F3 13	G3 18
E4 13	F4 12	G4 13

Culture 244. Height of plants as follows:

A1 15 mm.	B1 13 mm.	C1 15 mm.	D1 12 mm.
A2 22	B2 12	C2 15	D2 18
A3 17	B3 15	C3 17	D3 10
A4 13	B4 15	C4 18	D4 10

E1 15 mm.	F1 15 mm.	G1 10 mm.
E2 25	F2 17	G2 18
E3 13	F3 17	G3 25
E4 12	F4 12	G4 12

Dec 15, 1909.

Culture 195. Sprinkled with [illegible] sand yes-today. Sand green on the top in places.

Culture 157. Half sprinkled with [illegible] sand yesterday, not green on top to-day. The half sanded contains 9 plates, the other half 5.

Dec 2, 1907

Cistus 21. Many seeds now germinating.

Cistus 228. Pan moved from the propagating frame, where it was frozen through, to the cold house; then plunged in sand and left exposed to the sun.

Cistus 3.153. Two plants in the cold house making no growth; the leaves purpling and some shedding.

Cistus 157 No growth, leaves purpling.

None of the 1/3 [illegible] in the cold house [illegible] young or old plant is making growth.

Calluna vulgaris. The twigs [illegible] very slowly in the cold house, 1 to 3 mm in [illegible] in a month.

Dec. 20, 1909.

Culture 229. Fourteen root cuttings taken out as 229A a week ago.

Culture 229A. Fourteen root cuttings taken out a week ago and set in the cutting bed in the propagating house, in yellow sand. About [illegible] had a small callus and about two had new rootlets, according to Mr. Gage.

Culture 205. No more cuttings have sent up shoots besides the seven already noted. Of these seven three have lost their tips by drying and do not show above the sand.

Culture 155. Cutting in [illegible]-pot bed, from [illegible]. Thrown away.

Culture 192 + 192A. Plants all [illegible].

Culture 157. [illegible] plant has started in bulb pit.

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p. 18 Copied Dec. 20, 1907

13. The swamp blueberry is devoid of root hairs, the minute organs through which the ordinary plants of agriculture absorb their moisture and food.

The structure of the rootlets of ordinary agricultural plants may be understood by reference to Plate 14, which illustrates these organs as they occur in a wheat plant grown in a nutritive solution. Attention is directed particularly to the root hairs. It will be observed that the wall of the root hair is very much thinner than the wall of the cell from which ~~the root hair~~ it springs, and furthermore that the surface area of the root hair is many greater than that of the cell itself. The chief function of these root hairs is to absorb for the use of the plant the soil moisture and the plant food materials dissolved in it, a function

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which the root hairs are enabled to perform with great efficiency because of the two characteristics just mentioned, their large surface area and the thinness of their walls.

The rootlets of the blueberry are remarkable in having no root hairs whatever, as may be seen by reference to Plate 15. ~~The rootlets are very slender, ranging from 12 to 20~~ ~~[illegible] in diameter.~~ ~~ten times [illegible]~~ ~~[illegible] the thinnest rootlets [illegible]~~ ~~[illegible] epidermal cells are visible~~

The walls of the superficial, or epidermal, cells of the rootlets are thick, measuring

? ? as compared with for the walls of the root hairs of wheat. Notwithstanding, therefore, the fact that the blueberry roots are fine and numerous their actual absorptive capacity would appear to be small, in consequence of the absence of root hairs.

(over)

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~~A [illegible] wheat rootlet / can~~

It is found by a computation that a section of a blueberry rootlet, having no root hairs, presents
? about one the surface of an equal length of wheat rootlet bearing root hairs, and the ~~thickness of the~~ surface membrane ~~[illegible]~~
? in the wheat averages only about ~~[illegible]~~ that in the blueberry. Furthermore, the blueberry rootlet
? grows only about mm. a day under favorable conditions, while the wheat
? rootlet grows about times as fast. In all this provision for rapid food absorption in the ~~other~~ one plant and retarded absorption in the ~~blue-~~ other ~~berry~~ we find a reason for the comparatively very slow rate of stem growth that characterizes the blueberry plant. The importance of slow root absorption ~~in the roots of these plants~~ and the danger to which these plants would be subjected if their roots absorbed water rapidly is discussed on page

24

The young rootlets of the blueberry, before they branch, are exceedingly slender, varying from .0012 to .0020 inch in diameter. This makes them very susceptible to actual drying and they are easily killed by it. This characteristic has an important bearing on the treatment of these plants when in pots. The matter is discussed on page

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17. The rootlets of healthy plants of the swamp blueberry are inhabited by a fungus, of the sort known technically as an endotrophic mycorhiza.

As already stated the ultimate rootlets of the blueberry are very fine, their diameter varying from .0012 to .0020 of an inch in diameter. In rootlets of the smaller size about three rows of epidermal cells are visible in a lateral view, in the larger rootlets about five rows. In a newly grown rootlet not contaminated with soil particles these epidermal cells, and indeed all the underlying cells as well, are as transparent as glass, and were it not for the difficulties due to the refraction of light the examination of the contents of these cells would not be difficult. As a matter of fact the study of the contents of the live cells is diffi-

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cult, their intelligent examination requiring the use of an oil immersion objective and microscopic enlargements of to diameters. The darkened window installation for a microscope, devised by Dr. N. A. Cobb and used in his laboratory, has been found almost indispensable in this work. The writer is greatly indebted to Dr. Cobb for the use of these facilities.

Clean rootlets may be procured readily from ~~growing~~ active blueberry plants in the open spaces between half rotted leafblades, or in clean sand, or in live sphagnum, or at the outer surface of the ball of soil in earthen pots. Rootlets taken from live sphagnum are especially clean.

-2

-3

They are conveniently studied when simply placed in water, ~~in water~~ a thin cover glass,

¶ Ordinarily the only thing visible in one of the live epidermal cells is the minute cell nucleus, as shown in plate 15, figured, lying close to the cell wall. The protoplasmic membrane lining the cell is very thin and is invisible except where it is thickened to

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envelop the nucleus. The remainder of the cell is filled with the colorless cell sap. An examination with medium enlargements will show some of the cells faintly clouded in appearance. A higher power, such as is afforded by a oil immersion objective and an eyepiece, with proper illumination will resolve the cloudiness into a mass of fungus, threads hyphae, ~~or~~ ~~threads~~. These may be few, making only two or three irregular turns about the interior of the cell, as shown in plate 16, figure a, or they may be more numerous, even occupying the whole sap space, as shown in figure b of the same plate, in a dense knot of interwoven and irregular snakelike coils. These hyphae are about one ten-thousandth of an inch (2 to 4 μ) in diameter.

On the outer surface of the cells containing these fungus threads others of similar thickness may be observed. Sometimes they are trans-

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parent and their detection requires the same high power of the microscope as do those in the interior of the cells. Sometimes, however, these exterior threads ~~are~~ have a pale brown color and are then readily seen. Their surface is smooth, devoid of markings of any kind. Ordinarily the ~~[illegible]~~ thread wanders loosely along the surface of the root giving off an occasional branch, and having an occasional septum. Sometimes the threads and their branches may form an open network about the rootlet, as shown in plate 16, figure , but they never form a dense sheath of hyphae such as is characteristic of the mycorhiza of the oak.

The connection between the external and the internal hyphae is not easy to see at a single observation, for the ~~passage of which~~ the hyphae ~~passes~~ through the cell wall is rarely

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caught in optical section, and even then a clear observation is usually rendered difficult because of refraction. A very clear case, however, was observed in a rootlet of laurel, _Kalmia latifolia_, a shrub which has a mycorhizal fungus similar to that of the blueberry. A drawing of that specimen is shown in plate , figure

The passage of the fungus through the cell wall may frequently be observed by first focusing on the external hypha at a point where it appears to have a lateral bump or a very short branch, and then focusing slowly downward. In this way one passes from the external to the internal part of the fungus, having had some portion of the intervening hypha continuously in view. The hypha always

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appears much constricted at the point where it goes through the cell wall.

This fungus is of the type named ? by Frank in 18 as an endotrophic mycorhiza, to distinguish it from an ectotrophic mycorhiza such as occurs on the roots of oaks. In the latter type of mycorhiza the hyphae of the fungus form a dense sheath around the rootlet, completely shutting it off from direct ~~contact~~ with the surrounding soil. The loose hyphae on the outside of the sheath resemble root hairs and it is supposed to be a part of their function to absorb soil moisture and transmit it to the oak rootlet just as root hairs do.

It has not yet been possible, for

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want of time, to study the life history of this mycorhizal fungus of the blueberry. There is however a clue to its identity in the work of Charlotte Ternetz

24) described on page

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Dec. 27, 1904.

Culture 1[illegible]. In several plants the leaves which were half grown when the flat was brought into ~~[illegible]~~ house no. 1 have withered, the house evidently being too warm and the change too great. The tips, however, did not wither and new leaves are pushing out between the withered ones

Culture 204. Good growth has taken place in house no. 1 on nearly all the plants. Two young leaves are developing on the largest plant, the one that had remained dormant for some time before coming into house no. 1.

~~[illegible]~~

~~[illegible]~~

The soil between the pots of outdoor plants is frozen an inch deep where not covered with snow, and not frozen at all where the two-inch covering of snow still remains.

The hibernating frame, which for several days past has been covered with [illegible]

(over)

in addition to [illegible] [illegible] belief?

is ~~[illegible]~~ [illegible] [illegible]

(but necessary?) They [illegible]

happen?

Dec. 2[illegible]

Culture 230 Height of plants to-day.

Label

1	2	
2.8 cm.	3.5 cm.	
3	4	5
4 cm.	4.5 cm.	3 cm.
6	7	
4.3 cm.	2.2 cm.	

[illegible]) [illegible] / [illegible].

Plant no 3 ~~The 4 cm. plant~~ has two basal shoots, from the cotyledon axils, 5 and 10 mm. long, eleven foliage leaves. Only none of the plants is the tip withered.

Culture 231. Height of plants to-day.

Label

4.5 cm, 3 cm

3.7 cm. 3.7 cm. 4 cm.

2.5 cm 3 cm

6) 27.7 / 4.

None of the tips is withered, and none of the plants has a basal shoot.

Culture 198 Height of plants to-day

Label

1.5 cm (early injured) 3.5 cm.

2.8 cm.

3.5 cm. 1 cm (early injured)

[illegible]) 14.8 / 3.3

p. 24 Copied Dec. 28

15. The mycorhizal fungus of the swamp blueberry appears to have a beneficial effect upon the blueberry plant.

The epidermal cells ~~in~~ which the mycorhizal fungus occurs to differ in no respect from other epidermal cells of the blueberry rootlets. ~~They~~ are not swollen nor distorted, nor do their contents collapse. They appear In rapidly growing rootlets the ~~mycorhizal~~ fungus seems not to be able to keep pace with the rootlet itself and the fungus may not occur for a considerable distance back from the growing tip. The fungus-filled cells ordinarily are most numerous on the small short lateral rootlets the growth of which is slow. When root growth of a vigorous plant is retarded or becomes even stagnated the fungus may invade the epidermal cells to the very tip. Sometimes half the cells in such a rootlet

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are gorged with fungi, yet the
delicate cell walls show no displace-
ment or distortion. There is no indi-
cation whatever that the ~~mycological~~ fungus
causes any pathological disturbance
or is in any way obnoxious to
the plant. On the contrary the uni-
formity with which it has been
found to occur on healthy plants
and its frequent absence or scarcity on
sickly plants are facts suggestive
of a beneficial influence.

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17) The deficiency of available nitrogen in the acid peaty soil — which the swamp blueberry grows best is due to the inability of the nitrifying bacteria to thrive in such a soil, because of its acidity.

In order to understand the conditions antagonistic to nitrification which exist in good bluberry soils it is necessary first to discuss the source and transformation of nitrogen in ordinary soils.

The available nitrogen in the soil, such as is absorbed by an ordinary plant, is usually derived, unless fertilizers have been applied, from the decomposition of the humus contained in the soil, and the humus is itself a product of the decomposition of plant and animal remains. These remains (over)

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~~[illegible] matters~~ consist ordinarily and chiefly of the partially rotted leaves, stems, and roots of plants.

In the older agricultural literature the name humus was applied to a particular kind of soil, which is

more properly covered by the terms vegetable mold, leaf mold, and
(10) woods mold. (See page) Later the application of the word humus was restricted to that portion of a soil consisting of the plant and animal remains, in whatever stage of decomposition. The proper designation of these remains is, however, organic matter. The word humus is still frequently used
In the sense just described the
but not, it is now considered with correctness and precision. Humus as now understood by agricultural chemists represents a stage in the decomposition of organic matter in which the cellular structure has wholly disappeared and the original substance is or has been entirely dissolved.

Desert Botanical Laboratory
of the
Carnegie Institution

Since it is often necessary to allude to organic matter in the earlier stage, as distinguished from organic matter as a whole, which includes the humus stage as well, the term structural organic matter is suggested is suggested as a convenient designation. In structural organic matter the cellular structure of the animals or plants still remains and may be detected either by the eye or by the microscope.

Humus does not ordinarily exist in the soil in a dissolved condition but is usually combined with lime or magnesium as calcium or magnesium humates. These are not soluble in water but form a black precipitate, which gives a dark color to the soil.

To extract its humus a soil is first washed with dilute acid, by which the lime, magnesium, or other bud-

Baiyesde ?

(over)

mus-precipitating substance is dissolved and leached away. The humus itself is then removed from the soil by long continued washing with a weak solution, commonly 4% of ammonia.

When this inky black extract is
evaporated to dryness the residue
is a black substance which when
scraped from the dish resembles ~~finely~~
~~broken~~ coal dust or, even more closely,
burned sugar. This substance is
humus. It absorbs water readily,
assuming the texture of thin jelly.
It has a somewhat sooty odor and taste.
It dissolves slowly in water, giving
the fluid an amber to dark brown
color. The solution is slightly
acid in reaction. A liter of water
in which had been dissolved a
gram of humus extracted from
Kalmia peat showed when tested
? a % normal acidity.
The process of decomposition by
which organic matter still retaining
its cellular structure is trans-
formed into humus, in which the
cellular structure has entirely dis-
appeared, is known as humification.

Humus is rich in nitrogen, but the nitrogen is not in the form of nitrates and therefore cannot be assimilated by ordinary plants. The transformation of humus nitrogen into nitrates occurs during a further process of decomposition known as nitrification.

The nitrification of humus is brought about by certain bacteria which growing in the humus-laden soil under suitable conditions produce first nitrites and then nitrates.

In artificial cultures, in addition to proper conditions of temperature, moisture, and good aeration, these nitrifying bacteria require for vigorous growth a neutral or slightly alkaline medium.

In a distinctly acid medium the nitrifying bacteria ~~will not~~ grow little or not at all.

In order to ascertain the degree of nitrification, if any, taking place in kalmia peat, the following experiment was made by Mr. ~~Karll~~ F. Kellerman.

Experiment.

~~15. The rootlets of healthy plants of the swamp blueberry are inhabited by a fungus, of the sort known technically as an endotrophic mycorhiza.~~

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18. From the evidence at hand the presumption is that the mycorhizal fungus of the swamp blueberry transforms the non-available nitrogen of peaty soils into a form of nitrogen available for the nourishment of the blueberry plant.

It is a well established principle of plant physiology that only those plants which contain chlorophyll, the green coloring matter of leaves, are able to grow on mineral substances alone, and to put these substances together into organic plant foods.

All the plants without chlorophyll, including the fungi, are dependent for the fundamental part of their nourishment on the organic foods originally elaborated from minerals by the chlorophyll bearing plants.

Fungi may be directly parasitic on a chlorophyll bearing plant, as in the case of the mildew fungus of rose leaves; or they may grow on substances derived from chloro-

phyll-bearing plants such as bread 23
or jelly. ~~or they may grow on animal substances such as cheese, also derived ultimately from the chlorophyll plant substances eaten by the animal.~~

Fungi are particularly abundant in the decaying vegetable matter forming the leaf litter of a forest, even though this litter may be distinctly acid in its chemical reaction. They are known to grow luxuriantly on vegetable remains containing no nitrates and of such acidity that nitrification of the humus cannot take place.

That the mycorhizal fungi, like other fungi, are able to extract nitrogenous food from the unnitrified organic matter with which their external portions are in contact is a reasonable supposition. It is furthermore a reasonable supposition that the blueberry plant

17 ~~18.~~ The deficiency of available nitrogen in the acid peaty soil in which the swamp blueberry thrives is due to the inability of the nitrifying bacteria to thrive in such a soil, because of its acidity.

is ___ able to absorb nitrogenous material from the internal portion of its mycorhiza; for we know that the clover plant is able to absorb nitrogen under essentially the same conditions from the nitrogen-fixing bacteria growing in its root tubercles.

To establish by direct experiment the ability of the mycorhizal fungus of the blueberry to act in accordance with the supposition outlined above the fungus should be separated from the plant and grown by itself in suitable nutrient media. Preliminary many trials were made to isolate the fungus, but without success, and a lack of time has prevented thus far the pursuit of that branch of the experiments.

~~17~~. The acid peaty soils in which the swamp blueberry thrives are deficient in available nitrogen although containing large amounts of non-available nitrogen.

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19 It is probable that the mycorhizal fungus of the swamp blueberry transforms the free nitrogen of the atmosphere into a form of nitrogen suited to the use of the blueberry plant.

The fact of the fixation of atmospheric nitrogen by the bacteria inhabiting the root tubercles of clover is now well known, and we are able to understand how the abundant nitrogen of the air, unavailable for the direct nutrition of ordinary plants, is made available for the use of leguminous crops.

It is not so generally known that there are in soils certain species of bacteria not connected with the roots of plants, which also possess the faculty of taking up the nitrogen of the air and transforming it into nitrates. The extent of the distribution of these organisms,

~~15~~ ~~16.~~ ~~The mycorhizal fungus of the swamp blueberry appears to have a beneficial effect upon the blueberry plant.~~

[illegible]
Azotobacter and Clostridium
Molds.
[illegible] on mycorhizae.
Theory of mycorhizal nutrition

and the amount of nitrogen fixation effected by them are not fully known, but the fact that such action does take place and that the bacteria causing it occur in many localities has been well established by the experiments of several investigators. The bacteria of this class most fully investigated are *Azotobacter chroococcum* and *Clostridium pasteurianum*.

It has been shown also that certain fungi, such as ?

possess this same power of assimilating atmospheric nitrogen.

After the writer had discovered the mycorhizal fungus of the swamp blueberry in December, 1907, and while he was making observations on it, his attention was called to the work of Charlotte Ternetz on the mycorhizal fungi of certain related European plants. Miss Ternetz published in 1904 a

paper* in which she made the preliminary announcement that a fungus isolated from the roots of the European cranberry (*Oxycoccus oxycoccus*) had developed pycnidia and that the mycelium produced from spores from these pycnidia, when grown in a nitrogen-free nutritive solution but with full access to air, showed upon analysis that it had assimilated ~~th~~ free atmospheric nitrogen to the extent of .6% of the dry weight of the mycelium. The fungus consumed only one-eighth as much dextrose

*Charlotte Ternetz, Ph.D. Assimilation des atmosphärischen Stickstoffs durch einen torfbewohnenden Pilz. Ber. Deutsch. Bot. Ges. 22: 267-274. 1904.

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in assimilating a given amount of nitrogen as was consumed by Clostridium pastorianum. Similar but not identical fungi were isolated from other related plants.

In 1907, in a more detailed account of her investigations* Miss

*Charlotte Ternetz, Ph.D. Ueber die Assimilation des atmosphärischen Stickstoff durch Pilze. Jahrb. Wiss. Bot. 44: 353-408. 1907

Ternetz described, ~~in detail,~~ as new species of Phoma, five pycnidia-bearing fungi bred from the roots of the European cranberry (Oxycoccus oxycoccus), the marsh rosemary (Andromeda polifolia), two species of heather (Erica tetralix and E. carnea), and the mountain cranberry (Vaccinium vitisidaea). She was unable

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to demonstrate absolutely that these fungi were identical with the endotrophic mycorhiza of the host plants because (1) ~~the~~ it was extremely difficult to observe the fungus threads of the internal mycorhiza grow through the cell wall of the rootlets into the culture medium without, and (2) because when she proposed to inoculate mycorhiza-free seedlings of the host plants with spores from the pycnidia that formed in her cultures she was unable to grow any seedlings that could be kept free from mycorhiza.

Notwithstanding the lack of an absolute demonstration that the nitrogen-fixing fungi grown by Miss Ternetz were identical with the mycorhizal

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fungi of their hosts, the probability of their identity amounts almost to a certainty. It is regarded as strongly probable, therefore, ~~is a great probability~~ ~~There can be little doubt~~ that the mycorhizal fungus that ~~of~~ to occur in perhaps ~~probably~~ all plants of the heather and blueberry families, including the swamp blueberry, are nitrogen-fixers, and that the host plants absorb this nitrogen, giving in exchange, for the use of the fungus, sugar or some other carbohydrate.

The experiments thus far described in the present paper, and the accompanying discussions, appear to warrant the following theory of the method of nutrition of the swamp blueberry.

a. The swamp blueberry grows in peaty soils which contain acid

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or other substances poisonous to plants.

b. As a protectection against the absorption of amounts of these poisons great enough to prove fatal this plant, like many other bog and acid soil plants, is devoid of root hairs and consequently has a low capacity for absorbing soil moisture. To accord with its low absorption capacity it has a reduced rate of transpiration. Many bog ~~shrubs~~ shrubs, although living with an abundant supply of moisture at their roots, have been recognized as showing adaptations for retarded transpiration similar to desert plants.

c. The special danger to which the swamp blueberry is exposed by reason of its low transpiration

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and reduced capacity for absorption is insufficient nutrition~~, so far as those elements are concerned which are ordinarily absorbed by the plant from the soil.~~ The danger of nitrogen starvation is particularly great since these soils contain very little nitrates.

D. Some bog plants similarly threatened with insufficient nutrition, such as the sundews, the bladderworts, and the pitcher plants, possess means of securing the requisite nitrogen by catching insects, and digesting and absorbing their nutritive parts.

E. In the swamp blueberry the required nitrogen is secured in a different way. The plant ~~It~~ possesses a mycorhizal fungus which is able ~~[illegible]~~

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~~[illegible]~~ to assimilate nitrogen from the surrounding organic matter and from the atmosphere and to convey it into the plant without taking along with it a large amount of the poisonous soil moisture.

While this theory of the nutrition of the swamp blueberry may not be substantiated in all its details by future investigation ~~[illegible]~~ ~~[illegible]~~, it has afforded a useful basis for cultural experimentation, as will be shown by the results about to be described. ~~[illegible]~~

~~[illegible]~~

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November 29, 1898

Culture 239. No tip withered, but uppermost leaf rudiment standing still in many.

Culture 240. Tips withered as follows:

A_2 A_3 B_2 D_2 D_3 (blackened) E_1 (blackened) G_3	In general the live tips are somewhat stagnant. Several besides the seven withered ones look as though they might wither.

Culture 241 No tips withered, many stagnant

Culture 242 Tips withered as follows.

E_3 (blackened)

Many tips stagnant. ~~[illegible]~~

Dec. 30 '98.

Culture 239 Tips withered:

A_3

B_1 B_2

C_2 C_3

Culture 241 Tips withered.

B_2

E_1

Culture 243 Tips withered.

D_2

Culture 240 Tips withered:

A_2 A_3

B_2 B_4

D_2 D_3 (blackened)

E_1 (blackened), E_2

G_3

Culture 242 Tips withered

A_3

B_2

E_3 (blackened)

Culture 244 Tips withered:

None.

(Compt. Rend. 116: 1385-1388) Dec. 31, 1908.

In 1893 Winogradsky announced the discovery of a soil microbe shown by his experiments to be possessed of the power to assimilate free atmospheric nitrogen.

In 1894 (Compt. Rend. 118: 353-355) he published an additional note on the same subject.

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Mycorrhizal plant cultures.

Culture 73. Eighteen drained glasses of thumb pot size, ~~4~~ 6 with blueberry plants, 6 with rose, 6 with clover, in a soil containing Kalmia peat 8 parts, silver sand 1 part, clay loam 1 part.

Culture 74. Same as 73, with the addition of half the whole bulk of freshly rotted unleached cow manure. Six blueberry plants.

Culture 75. Same as 73, with a quarter of the whole bulk of cow manure added. Six plants.

Culture 75a. Same as 73, with [illegible]

Culture 76. Same as 73, with 1% carbonate of lime added. Six plants.

Culture 77. Rose soil mixture (Mr. Dimmis, consisting of clay loam 5 shovelfuls, well rotted unleached cow manure 1 shovelful, unslaked lime 1 tumblerful. Six blueberry plants, 6 rose plants, 6 clover plants.

Culture ~~81~~ 78. Silver sand, watered with a slightly alkaline nutritive solution. Six plants.

Culture ~~82~~ 79. Silver sand, watered with a slightly acid nutritive solution. Six plants.

Culture 80. Kalmia peat. Six plants.

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Office of
Taxonomic Investigations.

Experiments. 1908–1909

Take a blueberry plant growing thriftily in a suitable acid soil, and with mycorhiza in abundance on its roots. (Make bacterial tests if practicable.)

Water with a very weak alkaline solution, preferably lime, and watch the effect on the mycorhiza and on the plant, making also bacterial tests from time to time.

The question is, Does the growing alkalinity of the soil affect the plant directly or through ~~the~~ a deleterious action on the mycorhiza

Drinking glass cultures

Culture 81. Silver sand. Six plants.

Culture 82 Same as 81, with peat mulch added after the plants are well and uniformly established in the sand. Six plants.

Culture 83. Same as 81, overlain by growing sphagnum, but the sphagnum not added till the plants are well and uniformly established. Six plants.

Culture 84. Clay loam. Six plants

Culture 85. Same as 84, with peat mulch

Culture 86. Same soil as 73. Six plants.

Culture 87. Same as 86, overlain by growing sphagnum.

Experiments proposed

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